THE FIELD OF PSYCHOLOGY

A SURVEY OF EXPERIENCE
INDIVIDUAL, SOCIAL, AND GENETIC

BY

MADISON BENTLEY, Ph.D.

PROFESSOR OF PSYCHOLOGY AND DIRECTOR OF THE
PSYCHOLOGICAL LABORATORIES IN THE
UNIVERSITY OF ILLINOIS

D. APPLETON AND COMPANY
NEW YORK :: 1924 :: LONDON

PRINTED IN THE UNITED STATES OF AMERICA

PREFACE

From time to time the sciences pass through periods of great instability and unrest. Old categories are then brought under suspicion, fixed concepts revised, and new points of view eagerly sought. The occasions which introduce these disturbed eras are various. New facts may weaken old doctrines, as in modern physics, or a new way of regarding nature, as in the Darwinian biology, may lead to an upheaval and ultimately to the laying down of new foundations. But besides new knowledge and new points of view, novel distractions from without and even foreign doctrines and cults may, by their fascination or their glamour, disturb the serenity of accepted knowledge—especially where that knowledge is unseasoned or unattractive—and thus engender discontent and a demand for radical changes.

It is plain that, whatever the causes and the occasions may have been, psychology has just now passed through a restless decade. The signs of disturbance are still very clear in America; and they are not wanting in England and upon the European Continent. One of the disturbing factors appears to have been the recent temporary employment of psychologists outside their own domain; another the increasing diversion of interest toward education, medicine and commerce; and still another the undisguised reproaches brought against psychology for its cloistered air of aloofness in a needy and "practical" world. Again, we see, in looking for significant circumstances, a wide adherence to the behavioristic maxim that "restless activity alone makes the man," while the cults of healing and of Hygeia place their emphasis upon the abnormal and upon the psychoanalytical rites of purification.

The marks of disorder in psychology, exaggerated, it may be, by the inveterate tendency of the patient toward "introspective" brooding, have recently led to a sober consultation of eager "experts" ready to diagnosticate, if not to cure. The counsel of one is exercise, to be actively taken in the busy, work-a-day world; another would eradicate the obsession of experimental accuracy and substitute for it a fixed belief in the power of clinical divination. One advises the patient to "lose his mind" in pure behaviorism; another to release his struggling and libidinous soul; still another, preferring radical methods, suggests transplanation upon the amorphous body of "education"; while the biometrician insists that the only hope lies in a sudden metamorphosis of the student of mind into a human measuring-rod for "intelligence." In the meantime the public, always impressed by the occult powers of the medical priesthood and half-persuaded that the patient is only a temperamental *malade imaginaire* about to mend his ways, is crying upon the streets the "New Psychology."

Who shall decide where counsel is clouded and when doctors disagree? Surely not the patient; unless perchance the patient should discover that his state is, after all, not really pathological. He may decide that new surroundings, new neighbors, and new employments have muddled him; that what he most needs is a run, a plunge, and an hour of calm reflection with a clear head. As for the "new psychology" of the daily papers and the popular magazines, we have had it constantly with us for many decades. In fact, the eighteenth century recognized it in its *Erfahrungsseelenlehre;* Herbart recreated it in a mathematical and "scientific" form; it reappeared in Fechner's *Psychophysik* and in Wundt's *physiologische Psychologie.* In America it was common talk in the nineties (when, by the way, the psychologist was reading Freud), and each of the last two decades has echoed it. Always the "new," the revolutionary; albeit a *new* "new" with a constant shift of content and connotation.

But when we have made due allowance for the exaggeration of the passing moment and for a faulty perspective in time, we must still acknowledge that psychology is further from its moorings than it was at the end of the century. Then it had its compendious and articulated works. It had its Wundt, its Brentano, Stumpf, James and Ebbinghaus, to give a systematic setting and to orient the entire subject. Since that time a bare quarter-century has produced a literature approximating fifty-thousand titles, most of them monographs and articles not integrated into any system or so much as representing any common point of view. It is, in part, this difficulty which afflicts the psychologist at the present time. He grasps here and there for a support or for a principle of unification; but, unless he is satisfied with a partial view, as the "clinical" view of psychoanalysis, the "behavioristic" view of stimulus-and-response, or the "efficiency" view of "intelligence," he is without a foundation.

He who would go beyond these partial views and beyond a mere psychology-of-the-moment is obliged to reconsolidate the disjointed parts and to redintegrate the old and the new. Such a catholic survey is especially difficult in a restless and instable era. It calls for the most rigorous criticism and for the most unsparing rejection on every side. It means the salvage of all that is worth keeping from the psychological labors and laboratories of Europe and America; and it also means the extraction of whatever is psychologically substantial in Freudian doctrine, in behaviorism, in phenomenology, in the alleged arts of "testing intelligence," in the attractive doctrine of the *Gestalt,* and in all the other products and proposals of recent years.

The Field of Psychology attempts this difficult—almost hopeless—task of union and of integration. It appeals as little as possible to dogmas and theories; and it avoids as much as possible the neighborly distractions and allurements of biology, sociology, education and medicine. The entire treat-

ment rests upon the conception of the *psychosomatic organism,* that is to say, the total living creature which is at once bodily (or somatic) and mental. The mental aspect of this total organism appears first in *experience* (Parts I and II), and secondly as a resource of the organism in the *psychosomatic functions* (Part III). Everything is stated either in terms of experience or of conjoint function or operation. Experience is directly observed or inspected (the term "inspection" being substituted for "introspection"). Its *composition* reveals a wide qualitative variety, and its *integration* many organized structures and configurations. The functions are regarded as invariably involving both experiential (mental) and somatic (bodily) factors. The concept of pure "mental functions" is rejected; for it is found to be the *total organism* which perceives, remembers, imagines, acts and thinks. A critical study of the methods of test and of psychophysics falls under the "limits of psychosomatic function." The difficult problems of *sociality* and *development,* usually treated as separate and detached matters, are here regarded just as the more general problems are. Thus sociality is the accretion of social meaning to the psychosomatic functions; and psychological development, whether of the individual or of the species, a series of progressive changes in the total organism and its capabilities.

It is not the intent of the writer to give an exhaustive account of psychological facts. That is a task which might well terrify all but the most gifted, the most industrious, and the most macrobiotic of men. The present survey is limited to such a view of the field as can be seen from a single point of regard and can be defined by a meagre choice of empirical principles.

It is obvious—if the present account is taken to be fairly representative—that the field here surveyed is by no means a flat plain. The exposition labors over mountainous ridges, hurries across well tracked and fertile plateaus, toils in morasses, drones through arid deserts, and pauses for refresh-

ment in the occasional oasis. Only the caves of the unconscious does it avoid, leaving to some modern and martial son of Ægeus the exploration of the labyrinth. The Minotaur once despatched and the caves deserted, the "abnormal" may again be found among the topographical features of the open field.

Acknowledgment is made to the following publishers for permission to use illustrations for the text: P. Blakiston's Son & Company; Columbia University Press; Harcourt, Brace & Company; Houghton Mifflin Company; J. B. Lippincott & Company; Macmillan Company; Psychological Review Company and W. B. Saunders Company.

Colleagues upon the departmental staff at the University of Illinois have greatly improved the text by criticism and suggestion. To Miss Edith Bentley and to Dr. Rufus Clarence Bentley the author is heavily indebted for their painstaking labors expended upon the manuscript and the proofs. His wife, Margaret Russell Bentley, has worked constantly with him, both through the composition and in the preparations for the press.

M. B.

URBANA, ILLINOIS

CONTENTS

THE FIELD OF PSYCHOLOGY

THE FIELD OF PSYCHOLOGY

CHAPTER I

INTRODUCTION

The Approach to Psychology

We all know that thoughts and emotions, desires and memories, somehow belong to the domain of the psychologist; just as we all know that the study of heat falls to the physicist and the explanation of the action of acid on marble to the chemist. Of course such a vague reference of obvious and familiar facts to their proper subjects of study does not imply either an exact knowledge of the facts themselves or our ability to speak the language of any one of the sciences. But we have to begin with the scraps of information already acquired if we are to progress in our serious inquiries after knowledge.

Our common experiences are continually suggesting the physical sciences, the sciences of matter and energy, of life and of the constitution of the earth; but just as much do they constantly hint at things "psychological" in the homely events of every day. When you have ridden at the wheel of a motor car you must have observed a connection between the speed of the car and your thoughts and feelings. The exhilaration of a crisp morning and of a free conscience is likely to be reflected in an open throttle and a contempt for

curves; while baffled thinking and uncertain plans bring the car down to the pace of a snail. Decision, resolves, high moods and firm intent tell in the one direction; indecision, doubt and depression in the other. "Consciousness" or "the mind," as we say, has obtruded. It obtrudes also when an electric sign flashes past and leaves a greenish ghost or "after image" as you drive on into the night. The same kind of hint is given with the violent expression of feeling in the grand stand under an unpopular decision, or with a quiet exhibition of sustained fortitude in crushing sorrow. Feelings seem to lie at the very heart of mind. The dentist's office is painfully alive with "psychological" facts; the intimate roar and crunch of the drill, the sharp stab of the probe, the curious withdrawal of sights and sounds under the anæsthetic, and the gradual return to "consciousness." And less thrilling and impressive occasions have just as much their obvious "mental" aspects. You give up the quest for a forgotten name and suddenly find yourself pronouncing it without the least effort; you realize as you walk that a melody or a bit of dance music has been "running through your head"; or you learn to devote yourself to study in spite of noise and distraction. You note the lure of the brilliantly colored advertisement on the boards, the blind fury of the riotous mob, the ease of right-hand writing as compared with the awkward attempts with the left hand, the tongue's exaggeration of the size of a dental cavity, the shifting temper of a nation under the fortunes of war, the play of animals, and the short cuts of genius. Everywhere in daily experience are hints that we move as constantly and as naturally in the realm of "the mental" as among objects of the physical order.

Out of such stuff, then, exposed in its raw state, psychology collects and selects its materials. But the materials must be refined. Merely to note such experiences as the foregoing, even though they be our very own, will no more

make a psychologist than traffic in eggs will open the door to embryology. We must plainly mark the distinction between intimate acquaintance and scientific knowledge. Were intimate acquaintance a substitute for systematic and orderly knowledge, we might look for our most famous botanists in tropical jungles, for anatomists in the great meat-packing concerns, and for psychologists among the crowded tenements. More than a mass of material taken in the gross is required. Detachment is required, as well as the means for submitting the raw material to the methodical refinements of the sciences.

So it is not by chance that psychology develops, as physics, anatomy and embryology develop, in the laboratory and in the study. For here distracting interests and practical considerations drop away; the material is simplified, sorted, set into its proper context, and at last filed with other records of the science. The after image from the electric sign, for example, is here reproduced under the controlled conditions of experiment, repeated and varied at will and compared with other like phenomena. It then takes its place in the psychology of vision. So also the colored advertisement is withdrawn from the distractions of the street; it is studied as one of the means of "turning the mind" in a new direction, and thus it suggests a problem in attention. In the same way, the facts of insanity fall under the problems of the abnormal; idiocy and genius become matters for research upon capability; the orator and his audience are transmuted into problems upon the social integration of men; the "tune in the head" turns out to be a typical bit of auditory imagery; right-hand writing is made a study in the habituation of function, and grief takes its place among the emotions.

We see, then, that psychological materials lie all about us in the experiences of every day; but we see also that these materials are not really incorporated into psychology until

they are regarded by the trained observer, withdrawn for more favorable conditions of study, and passed through the alembic of the science. Now we go on to consider how the novice in the subject may make use of his meager store of unsorted and unrelated fragments to attain the point of view and the orderly knowledge of the psychologist.

If you will reflect upon your previous use of the words "mind," "mental," and "psychological," in connection with your own experiences, you will observe that the mental or psychological factors implied have been concerned, as a rule, with personal performances and attainments. You will discover that mind has appeared as an effective instrument designed to obtain some end or result. Thus we all seem to "employ our minds," as we say, in reading books and street signs, in deciding how to spend the vacation, in trying to understand difficult lectures and textbooks, in remembering forgotten names, in finding our way in the darkness, and in holding ourselves steady under failure and discouragement. So, too, in discussing the gifts and defects of others we speak of the enfeeblement of mind, of the great mental resources of the talented, and of differences of mental ability and mental accomplishment. We take for granted the "strength of thought" and the "force of will." Always an *acting* mind; always a mind at work; always a performance or accomplishment which enters into the affairs of life, bending events, with greater or less effectiveness, toward some desired end.

This is a perfectly natural and a perfectly inevitable first and informal view of mind. In a similar way do we know trees as active, growing, fruit bearing, and shade producing objects before we begin to gather our botanical knowledge. So do we have a fairly wide and varied knowledge of animals, of their habits, uses, and activities, before we enter upon our zoölogical studies; and we may be familiar with the lathe, the sewing machine, or the motor car, so far as

functions and operations go, without mastering the science of mechanics or attaining to an exact knowledge of materials or of machine design. In general, let it be said that our early pre-scientific acquaintance with ourselves, as well as with the common things about us in nature and in manufacture, is chiefly an acquaintance with uses, functions, and gross operations, and is not an exact and well-ordered comprehension of the character and the properties of "mental" objects.

This difference between mere acquaintance, no matter how intimate and searching, and coherent knowledge we must not overlook, then, as we pass the threshold of psychology. The distinction is of special significance at the beginning because "mind" first presents itself to us, outside psychology, as a peculiar, personal possession; as something which each one of us must perforce know and appreciate very much better than any mere "outsider" can. Besides this personal bias regarding "our" minds we all commonly employ such phrases as "paying attention," "exerting our wills," "controlling our emotions," "searching our memories," and "directing our thoughts"—phrases which have a psychological sound and which seem to imply a fairly high sophistication regarding ourselves. As a matter of fact they usually imply no more knowledge of psychology than our glib references to a "sluggish liver," a "touch of indigestion," or a "twinge of rheumatism" imply accurate knowledge of the physiological disturbances which afflict our bodily interiors.

Now there arises from these sources an overpowering temptation to carry over into psychology our old conceptions and opinions of our own mental capabilities and excellencies. Regarded as knowledge these conceptions and opinions and these terms and phrases are spurious; they are not made of the true coinage of psychology. If we take them at their face value, they offer a decided hindrance to our entrance into serious study. It is like taking a wrong start at golf

or making a bad beginning in music. In describing the adventures of Gargantua, when that robust student went up to Paris to study at the University, Rabelais refers to a music master, one Timotheus, who was accustomed to exact a double fee of those students who came to him from other masters, observing that, in their case, at least one half of his time and pains was spent in removing the effects of bad antecedent instruction. The case of Timotheus is appreciated by every psychologist who has helped the novitiate through his first introductory weeks of study. It will be appreciated by the beginner, too, as he discovers how many wrong impressions interfere with his intent to master a new subject.

Like many other opinions and preconceptions which we acquire uncritically and without reflection, these troublesome assumptions about the province of psychology will be abandoned only when we have come to realize the source as well as the force of our makeshift and spurious knowledge, and also when we see as clearly as we can the new direction which we are to take. If we are therefore to follow the example of Timotheus far enough to insist upon the giving up of old prejudices and the relinquishment of inappropriate points of view, we must first look behind and discover the origin of our errors. We shall thereupon find that: (1) the whole trend of human tradition has misdirected the individual seeking psychological knowledge of a coherent and scientific character; (2) the philosopher and the biologist have confused him with matters not relevant to his endeavor; (3) language has misled him with the offer of loss and undefined terms; and, finally, (4) personal desires and interests have turned his attention from valid and objective information towards his own private concerns and eccentricities.

1. *Psychology and Magic.* Since there indubitably exists something which is constantly and confidently referred to as

"mind," it may seem strange to you that men have been slow in acquiring a straightforward and reliable account of it. The chief reason is not far to seek. The age of scientific description was preceded by unnumbered centuries of magic. Before men considered natural causes and formulated sober natural laws, they were governed by ritual and by a belief in spirits, demigods and divinities. The great men of those earlier times were the priests and the magicians. Instead of orderliness in nature men found caprice, cunning and malice. Nature was to be appeased, not understood and controlled. Gradually, in spite of magical traditions, came hints of a natural order. The storm arises—as man at last discovered—not from angry gods but from meteorological conditions, pestilence from the disregard of hygiene and not from the maledictions of an avenging spirit.

In the physical realm our own generation stands so far removed from the first conquests of science that magic there seems foreign to the present modes of thinking. To realize its ancient spell we have to search out such persistent superstitions as the bad luck of Friday, the omens of the new moon, the sinister import of the looking glass at funerals, and a vestige of the priesthood among family doctors. Concerning the magic of *mind* the whole case stands otherwise. There the human race at large still lingers in the twilight of credulity and superstition. There the occult is still respectable. Men who would scorn an invocation of spirits to account for the lightning and the volcano find nothing incongruous in an appeal to mystical agencies to explain the coincidental thoughts and longings of separated friends; and they accept, without understanding or criticizing them, such explanatory terms as "telepathy" and "hypnotic power."

The case is even worse. Among the unenlightened, mind is a mysterious agent which sweeps through space without a vehicle, defies time and the laws of nature, and controls destiny. But many persons of general intelligence, as well, entertain a prescientific notion of mind. Several hundred university students who were recently making their first approach to psychology were asked to set down in simple language their conceptions of its nature. Three fourths of the whole number appealed to declared that they believed mind to be some sort of power, faculty, force, or directing influence which controls the lives of men. Almost half of them regarded the mind as material, a substance to be identified either with the brain and nervous system or with a peculiar and subtle inhabitant of the body; while one in five

identified it with the "soul," "personality," or some other immaterial substance. Not a few were more vague, looking upon it as a mere receptacle or as an unknown something which was susceptible of training and development. Shreds of discarded philosophies, traditions of magical belief, expressions of a universal longing for power and influence, and unsorted scraps of physics and physiology!

2. *Psychology and Traditions of Learning.* Psychology has received a double heritage; the traditions of philosophy and the traditions of the sciences of life. All specialized knowledge goes back to philosophy, as it all goes back ultimately to magic. As soon as men began to elude the spell of the occult and while they were painfully trying to puzzle out nature's actual modes of operation, they turned aside to construct a reasonable and consistent account of the whole realm of existence. "What does life mean?" they asked. "What is the relation of man to nature?" "What are the final constituents of all substance?" Some of the early attempts to solve these riddles of the universe are to be found in the Greek cosmogonies and in the Vedantic and other classical writings of the Far East. They have exerted a profound influence upon man, who is always reverting to these persistent and really insoluble problems. Even physics and astronomy, the oldest of the empirical sciences of nature, required hundreds of years to shake themselves free from the entanglements of philosophy as well as from the spell of magic and superstition. At last they succeeded. Our text books in these subjects are now filled with sober facts and empirical principles.

Psychology has not come off so easily. Mind is intimately related to knowledge, and knowledge has belonged in a peculiar way to the metaphysician. Moreover, the intimate relations of mind to the personal and emotional sides of life have always tempted men to speculate. So mind has long stood under the shadow of philosophy as it has stood under the spell of credulity. Conjectures upon the creative and legislative powers of mind, as well as the half magical arts of palmistry, clairvoyance, physiognomy, mind reading, and "characterology," have always stood in the way of a straightforward comprehension of mental facts. But conjectures and speculations must be avoided by us at the outset; for they spring just as inevitably as does our magical interest from other attitudes than that of observation and description.

The tradition from the sciences of life is of an entirely different sort. The later generations of the nineteenth century have been called "biological" generations because of their extraordinary contributions to the biological sciences. The formulation of the laws of organic evolution, the establishment of physiology, and the application of chemistry to the facts of life are all landmarks. Instead of the old anatomy and medicine, which harked back to the Greek physicians, there are now to be distinguished a whole series of disciplines, historical, morphological, physiological, biophysical, ecological, and pathological. Life in all of its phases, including the congregate life of men and of animals, has been surveyed. The study of it has thus gained a marvelous prestige in the eyes of men; and incidentally it has in various ways encroached upon the domain of psychology.

Some biologists have thought of mind as only a "secretion of the brain," or as nothing more than a kind of inevitable froth which appears upon the eddying currents of life; others of them have looked upon it as a delicate regulator of the body; others again as an instrument of adjustment between the organism and its surroundings; and still others as a reservoir of energy which can be drawn upon for the welfare of the organism in health and in disease. These neighborly interests in mind have not failed to influence psychology. Indeed, certain psychologists, whose main affiliations are biological, have been frank to say that, for them, psychology was just a branch of the science of life, and mind, if it were to be considered at all, was to be considered only in so far as it modified and controlled the performances or the "behavior" of the body.

This biological view, which always places either life or "behavior" in the foreground and usually minimizes the facts of mind, is not the view which will be sustained in the pages which follow. The mental factors in experience will there receive due attention, although where these factors depend upon, coöperate with, or sustain any sort of factual relation toward the body and its functions, the dependence, the coöperation, and the relation will be acknowledged and defined. We shall, however, independently regard the primary facts of psychology, referring them neither to philosophy nor to the sciences of the body. This resolve may seem to restrict our survey to a small group of materials. It does not—as we shall presently see. Instead it will leave us free to consider practically all of the problems which have grown up in empirical psychology, but to consider them

from a single point of view, or, at the least, to place upon them a single kind of emphasis.

3. *The Difficulties from Language.* Language has a magic of its own. When once we have discovered the name for an unfamiliar object we easily persuade ourselves that we then know the object itself. A vague halo of familiarity hanging upon a name seems to acquaint us with the qualities of the thing named. At times we realize our ignorance only when we are asked to define or to describe. In giving the "vocabulary tests" it has been found that persons tend to claim knowledge where they cannot define. To many primitive folk the name is part and parcel of the thing or person; and when an individual gives his name he not only bestows a part of himself but he also makes it possible for the person informed to do him injury. Thus natives of the Torres Straits settlements refused to tell Dr. Haddon their names; "the idea being that by telling their own name to a stranger they were voluntarily putting themselves into the power of that stranger." Since words have so powerfully impressed the race and since they still play a large part in our understanding, it is not strange that we often accept the symbol for the thing signified. To the word "mind," for example, men often seem to themselves to attach concrete meanings when their actual knowledge is extremely hazy and vague. Thus "mind" is popularly supposed to "work" or to "refuse to work"; to be "concentrated" or "distracted." It is alluded to as "alert," "agile," "quick," "energetic," or "sluggish." Again mind is said to be "lost," "unbalanced," or "disordered." Men also regard it as a heritable thing, bearing family resemblance to ancestral minds, but capable of making its own way and of surmounting difficulties. Moreover, mind is said to be useful, in the forms of "intelligence" and "will," for the solution of problems, the acquisition of learning and the conquest of nature. It thinks, imagines, remembers, chooses, resolves; and it is "moved" by sadness and pity, "distressed" by grief, and "disturbed" by uncertainty and doubt. The word is undoubtedly useful to our common thinking; although we should find it difficult to say what kind of existence is implied by the elastic term. That fact is apparent from the phrases just now cited. A mind which works, which fails us, which is concentrated or distraught, is evidently an agent with powers. The epithets agility, quickness, sluggishness, etc., specify certain particular forms of power. We might call them the "gymnastic" qualities of mind. The possibility of loss, dis-

order, and unbalance suggests that these mental powers may suffer eclipse or derangement; and the emotional disturbances of pity, grief, and fear imply similar, if slighter, aberrations. In the same sense, a "heritable" mind would appear to be one which is racially equipped to perform duties for the individual, and "intelligence" and "will" are other expressions of a power supporting the organism in various exigencies of life. In the everyday and gross uses, then, the term "mind" tends to refer us away from the concrete experiences to an unknown cause, to a vast empty circle of whose properties we know little more than a vague understanding of the qualifying words employed.

We have, therefore, to turn to the psychologist. We go to him for a workable conception of the mental factors in organic function just as we go to the physicist and the chemist to learn about the atomic constitution of matter or to the biological sciences for reliable information about the structure and the history of living creatures. And when our common, rough-and-ready knowledge fails us and we resort to the sciences we must expect a certain amount of sophistication. The world of the chemist is not the world of the cook. The chemist looks upon the universe as vast systems of moving electrons. The atom itself is, for him, an ordered system of positive and negative electrical charges, some of which are traveling with the velocity of light. No such object ever appears within our ordinary visual range. The world of homely and familiar objects about us does not *look* or *sound* or *feel* as if it were so made. In a similar way, the student of life transforms familiar bodies into vast colonies of minute cells, each one of which is, in turn, exceedingly complex in structure and in its operations. Physics, also, transmutes our gay world of light, heat, sound, and color into a lightless, heatless, soundless universe of vibrating and oscillating changes. Thus each of the sciences, setting out from the phenomenal world of our casual inspection, creates its own interpretation of existence—an interpretation which is consonant with its own point of view and its peculiar problems. In this sense all accurate and technical description is sophisticated.

A difficulty which especially afflicts our own generation is the easy, unconsidered and unscientific way in which it is the fashion to use the terms "psychology" and "psychological." Almost everything which makes reference to the more intimate aspects of the life of man is now labeled "psychological." We hear of "psychological novels," "psychological plays," "psychological ser-

mons"; of "psychological healing" and "psychological methods in business." Golf has its "psychology," and so have chess and bridge, dress and education. The "psychology of" is one of those interesting phrases which mysteriously appear without warning, run glibly off the tongue, fill the popular magazines, and temporarily excite the public imagination. When such a phrase attaches itself to strong emotional interests, as to religion, health, sex, sport, recreation, and the fine arts, and when further it acquires, as "psychology" has acquired, the profound sanctions of science, medicine, and literature, its influence is likely to be deep and to pass beyond its own intrinsic merits. It is quite true that the advances of psychology have thrown light upon many matters hitherto obscure; but very often the phrase, "the psychology of so-and-so," indicates only a popular and worthless description couched in high-sounding, but ill-chosen, terms. Against these extravagances the novice must be on his guard until he is able to distinguish the genuine from the spurious. Once he is persuaded that whatsoever touches "human nature" is *psychological,* he is hopelessly lost and confused. There will then be for him no place to begin and no place to end. It would be as if zoölogy were extended to cover everything which concerns animal life. That would include the raising of cattle and sheep, the processes of the slaughterhouse, the care of pets and of domestic animals, hunting and fishing, and so on indefinitely. No; it is only quite special ways of regarding life, only quite definite means for the observation of living things, which fall to the student of zoölogy. And psychology is just as clearly and closely limited by special ways and special means. To be sure, there are psychological avenues of approach to "human nature" and psychologists are constantly referring to "mind" and to "mental facts"; but these points of regard and these facts always bear the stamp of a particular kind of intellectual interest and the impress of a particular science, which bring them within the borders of psychology.

4. *Mind Regarded as a Personal Possession.* Finally we may direct our steps toward a coherent and sound psychology only when we have come to realize that our naïve and pre-scientific view of mind has invariably been a personal and private view. Life is full of struggle and conflict; and just as man seeks control and contentment by annihilating space, by expanding or contracting time as his need suggests, and by conquering natural forces, so does he seek to match his wits against his fellow's, to gain

and to use knowledge for personal ends, to interfere in his own destiny, and to influence his family, his friends, and his fellow men at large. The chief instrument and resource, in these latter endeavors, is—as he thinks—his "mind." It is no wonder, then, that he holds it to be his closest ally, the "guest and companion of the body," as Hadrian sang, and that he considers it in a highly emotional and biased manner. But to value, to cherish and to use is not to know!

Three Fundamental Attitudes

Perhaps the simplest way to distinguish the point of view of the psychologist from the personal and confused view of everyday tradition is to observe that all human beings are so constituted that they automatically assume toward the world in which they live at least three unlike and conflicting attitudes. These are the attitudes of *knowledge, appreciation,* and *use.* When a person inquisitively examines a new kind of engine or typewriter, or puzzles out the meaning of a knotty sentence in a Latin text, or follows a lecture in chemistry, or reads library references in history, he assumes the attitude of knowing Thus one seeks to know, to search out by intelligent perusal, the object or the matter in hand. All serious inquiries after knowledge imply this attitude. Again, the concert, the opera, the ball game, the delights of friendship, the exhilaration of vigorous employment, the regard for human endeavor and human accomplishment, and the condemnation of wrongdoing, all imply the second attitude, the attitude of appreciation. When we appreciate, we enjoy, we judge, we approve, we condemn; in brief, we value. Finally, man's employment of the world and of its opportunities involves the attitude of use. Tools and instruments are, as a rule, regarded under the attitude of use. They are means to the accomplishment of our ends. The mineral stores of the world, the mines of coal and copper, of gold and silver, we generally regard in an utilitarian way. Business and commerce, the demands of war, and the conquest of a new land,

encourage men to assume the attitude of utility in order that they may accomplish their desires and command both nature and their own kind.

Toward many of the affairs of life and toward most of the world's objects we assume at different times and for various purposes all of these three major attitudes. We *know* the animal as a representative of such or such a zoölogical group, we *value* and appreciate it as a pet or companion, and we *use* it as a burden bearer and for food. The soil we study; the landscape we enjoy; and the land we compel to yield an income. The heavens themselves furnish the astronomer with materials for study and the mariner with useful points of reference, as well as all of us with the loftiest objects of contemplation that stir the imagination. Each period, each crisis in the world's history, lays its own peculiar emphasis upon one or another of the attitudes. The judgment which the historian passes upon peoples and times and civilizations rests in large measure upon the exaggeration or the neglect of value, utility, or knowledge. The period of the Renaissance in Europe is famous for its quickened spirit of appreciation. Italy "kindled at the core" and the northern countries awoke in turn to a new valuation of art, letters, and life. Men censure decadent Rome for its bad sense of values when opulence led it to neglect both the utilitarian and the inquisitive attitudes that it might with great license enjoy the spoils of its conquests. The last century was an era of inquiry. The physical sciences advanced in decades farther than they had in whole preceding centuries. Then invention and discovery created new products and new methods of production. Industry developed, utility was exalted, and "efficiency" tended to become an end in itself. So declined the attitude of knowledge before the ideals and the conveniences of utility.

All men, then, seek to know, to appreciate, and to use. No one of the three attitudes is to be set above the others,

as no one of them can properly take the place of the others. The normal course of life includes the appropriate assumption of each in its proper place. The sentimentalist is a person who abuses his appreciative attitude, adopting it upon occasions when he should either know or use. The man who is engrossed in business is tempted to neglect human and artistic values and to underrate learning. The pursuit of knowledge unrelieved by appreciation makes the pedant. The educated person, like Aristotle's "large-minded man," is the well balanced individual who gives to each of the demands of human life its due—who understands when knowledge is required, who appreciates when judgments of worth, whether æsthetic, moral, economic, social, or religious, are in place, and who uses the "goods" of the world with a proper regard for their values and with an intelligent conception of their nature.

Now the sciences are the result of man's steady and persistent attempt to compass the world in a coherent and objective way by the fixed assumption of the attitude of knowing. They seek, each in its own field, to describe, to understand, and to explain. Psychology belongs to this group. It seeks to describe and to understand experience and the activities of the total organism in which experience plays an essential part. It follows that the novice who seeks an introduction to the subject will find his path beset with difficulties so long as he insists upon carrying over to his serious studies the distracting mass of bias and misconception which has for centuries accumulated under the attitudes of use and appreciation, and which ministers, outside of psychology, to the layman's interest in things mental. The utilitarian view of mind is practical in the narrow sense of employment without knowledge; the appreciative view is the personal view of possession and of emotional regard. In his hours devoted to the serious study of mind the student soon learns to discard them both and to direct an open and unbiased inquiry

toward the sober facts which fall within the domain of the psychologist.

The Psychosomatic Functions

We have seen how men invariably bring to their initial study of psychology a profound conviction that mind is active and powerful; that mind is that part of man which thinks, feels, knows, chooses, decides, desires, and generally governs and legislates. But we have likewise seen that this conception is confused, vague and more than half magical because it confounds the attitudes of appreciation, utility, and understanding. It looks as though we should not, because of past misguidance, escape the double fee exacted by Timotheus. At the same time we must, as we observed at the very beginning, make what use we can of our fragmentary store of knowledge, sifting the true from the false. For there is a grain of truth in the popular conception which we may discover, now that we have examined its origin, by directly and steadily regarding the facts.

Let us drop our prepossessions and look at the "thinking," "desiring," "resolving," and so on, that mind is supposed to do. We may quickly reassure ourselves that thinking, for example, does, as a matter of hard fact, go on; and that it leads, moreover, to conclusions, to discoveries, to convictions, and to beliefs. Again, desiring is a factual performance. We do desire; and our desires do—at least at times—lead on to satisfaction. So with resolves; so with emotions; so with the thousand and one active experiences which we live through hour by hour and day by day. We do "perform," and we do accomplish; and the accomplishment points backward to a mental factor in our experiences which is not reducible to eyes and ears, to muscles, nerves and brain—not reducible, that is to say, to the physical parts and functions of the body. What then is wrong with our popular conception of these performances? Two things are wrong. In

the first place, the mental factor which goes into thinking, desiring, and the rest, is not an unknown and mysterious originator; it is *an observable and describable aspect of the organism.* In the second place, the mental factors thus involved *never act, perform, and accomplish*—so far as we ever observe—*save in conjunction with the body.* Both sayings are, at the moment, hard to credit because both stand squarely against our previous conceptions. They must, however, be taken by us with great seriousness if we are to gain and to retain the psychologist's point of view.

Keeping before us, then, this double caution against losing our psychological way, we may go on to survey the topographical features of the land immediately within our new boundaries.

First we should understand what the psychologist means by "organism." For when he says that thinking and desiring are performances of the organism, he does not mean exactly what the zoölogist and the physiologist mean by "organism." No; his organism is the mind-body. He alone studies the *total* organism. The bodily part of it is, to be sure, precisely what the anatomist describes. It is bone and sinew, organ and tissue, brain, skin, nerve, and the like. But the mental part of the organism is also included; and it is not our old magician of the caves who conjures in darkness and eludes—as Cupid eluded Psyche in the myth—the sight of mortals. It is just a manifold of individual facts or events of experience, each observable and describable, as iron and potassium are, in terms of their properties or attributes. When these things have been described and classified, both as individuals and in their natural complexes, "mind" has been exhausted upon the side of materials. Nothing more that is "mental" remains. The events *are* mind, so far as its composition is concerned. There exists, so far as we know, nothing behind them to pull the strings—no more than there is a hidden pumping faculty behind the heart and ar-

teries to account for the coursing of the blood throughout the body. Instead, it is just these mental events or "processes," organized together just so-and-so, and coöperating with muscles, nerve cells, sense organs, glands, and the like, which turn out thoughts, desires, resolves, and all the rest of the products of the total or *psychosomatic* organism.[1] The psychologist takes, then, a concrete instance of perceiving, acting, thinking, or desiring, and he observes what factors are actually involved. He finds in all these instances that it is impossible to describe the operation in physical and physiological terms alone. Besides the bodily factors there are also concrete mental factors; for example, visual and auditory qualities, strains from tendon, and a feeling of pleasantness. All the factors taken together in these performances are for him the organism. He does not create or presuppose this mind-body organism; he observes it. The functional performances, then, in which the mental qualities play a part, make the work of the psychologist unique. He finds two sets of factors, neither of which is reducible to the other. It follows therefore that his task includes not only the depiction of these double, two sided performances. He must also make a special exploration of the mental part, devise methods for observing these unique facts, and discover how the facts of mind stand conjoined and integrated in the concrete experiences.

It appears, therefore—and here we bring together all that has so far been said—it appears that what our confused and half magical conception of mind is laboring to express turns out to be certain psychosomatic functions or functions of the total organism. Now we know that thinking, perceiving, and the others are themselves neither mind nor a magical force or faculty which stands behind mind and prompts it, so to say, to its performances. Thinking is no more mind than

[1] The terms "psychosomatic" and "psychosome" are derived from the Greek words ψυχή, mind, and σῶμα, body.

gastric digestion is the stomach or than running upon the highway is the engine. It *implies* mind in the sense that it is never carried through save when mental resources (as well as the brain and certain other parts of the body) are pressed into service. Always mental resources and always bodily resources of the organism are called into use for carrying out these functional performances. That is why the psychologist calls them "psychosomatic" functions, thus distinguishing them from the purely bodily or "somatic" functions, such as the growth of bone and the operations of enzymes and ferments.

Since our ready-at-hand and everyday knowledge gives us a hint of these functions, they would seem to offer a natural place for beginning our exposition. But we cannot study perception until we know what the double resources of the organism are which are drawn upon in the apprehension of objects and events about us. So we must first explore these resources. We should not dare to undertake the mastery of the art of printing without first acquainting ourselves with type and the construction of the press. Nor do students of living beings seek to understand the processes of digestion until they have systematically studied the bodily organs involved as well as the character of foods and the substances within the organs of aliment which are necessary to these physiological processes. No; we must leave on one side our psychosomatic functions in order that we may first make a survey of the mental factors themselves. This survey will fall into two parts. The first part will be analytical. It will seek to describe the mental aspects of experience in simplified form. It will search out simple mental items, commonly called the "mental processes," describe and classify them, and show what their properties or "dimensions" are. This first part of the task, as regards the method of study, is like the reduction of chemical substances to more elemental forms in our introductory chemistries or like the reduction of the

organized body to the living cells of the anatomist. The second part will be synthetic. It will treat of the organization of mind, of the various qualities of experience as they are integrated in actual and concrete events. This will correspond, in a general way, to the investigation of chemical and cellular complexes in other sciences. Then we shall go on to the functions. These main parts of our study we must now examine with more care and deliberation.

The Subdivisions of Psychology

First in order stands the detailed description of experience. We cannot understand functions and activities until we know our organism. Every concrete mental factor—like every bodily factor—is complex. Its description, therefore, demands analysis. And the final result of analysis is the simple quality or other attribute. In our recent animadversion upon the distressing visit to the dentist's office, our brief analysis brought out the qualities of pain, pressure, the roaring noise of the drill, and the disappearance in anæsthesia of sights and sounds. Under the present view, these sensational items are to be described apart from the bodily conditions which underlie them and from the objects which they mean or signify. When they are so described, they bring us within sight both of the method and of the goal of our first division (Part I). To know how mind is composed is to know by direct and first-hand observation—that is to say, by the *method of inspection*—the processes which, taken together, make up the whole flow of experience. In fact, when viewed from the point of view of composition, mind is just the sum total of these processes taken as they come, simultaneously and in successive trains.

Now the objection has often been made to the method of analysis by "inspective" observation that it tears mind apart in an unnatural way, thereby destroying its essential character. The "sensations" and other "processes" are—so the

objection runs—only parts of a dead and mutilated mind. Well, it may be replied that the carbonized ash of burnt sugar is not sugar, and that the three elements, carbon, hydrogen, and oxygen, certainly are not, when taken severally and separately, the same as the material used to sweeten coffee. And, nevertheless, a large part of our knowledge of the sugars rests just upon the analytical procedure of breaking these substances down. The heart and muscles and nerves in the dissecting pan are not the frog which leaps and jumps and fills the swamp with liquid sounds; nevertheless, most of our knowledge of organic structure is derived from dissection.

Upon two points the objection entered against mental analysis must be carefully considered. First, we must admit that the simple qualities are not, as they are analyzed out and individually described, the mind of appreciation and not the mind of use. They do not think for us or thrill for us, any more than the black carbon masks the bitterness of our breakfast cup or than the throat muscles of the dissected frog make the evening melodious. But those things, again, are matters of appreciation and of use; matters which we have tacitly agreed to leave behind us in our approach to psychology. The second objection is more cogent. It maintains that you cannot completely know mind through analysis alone; that mind is organic; that it has a peculiar constitution which inheres just in the relation of part to part, which rests just upon the integrity of the whole. This objection is well taken. It holds also of animal dissection. Morphology, the study of form, is complementary to anatomy. The typical method of anatomy is dissection; the typical method of morphology is synthesis or integration. The former views and describes the parts taken in isolation; the latter views and describes the parts in organic combination.

Then we must reject half and accept half of the critic's contention. Inspective analysis does yield a valid descrip-

tion of the component parts of experience; but it leaves out of account mind's organization. That account is to be supplied in the chapters of Part II. The absorption in study under distraction, the involuntary glance at the brilliantly colored advertisement, and the smooth, easy running act of writing are instances. The absorbed individual's mind is so organized in rapt attention that foreign sounds do not break through, while the clever advertisement is devised in such a way that the visual qualities from it do break through the organized focus of attention and get themselves clarified. Again, habituation, which takes place gradually, under continued repetition, is just—on the side of mind—the consolidation into a compact mass of those factors which initiate and control such a skilled performance as writing or skating.

Until now we have spoken of the mental factors as if they existed apart from the body. But, so far as we know, they do not so exist. Everything which we include under the heading of "experience," everything which distinguishes our waking life of perception, desire, hope, effort, and the like from the deepest sleep or general anæsthesia is related, in an essential way, to the physical part of the organism. The living and functioning body must be presupposed. Trees, buildings, the earth, and the stars may be regarded as if the organism did not exist. That is to say, they are independent objects, and we so regard them in our common traffic with them and also in the physical sciences. But the mental facts involved in experience—the facts which distinguish psychology—always and without exception presuppose for their existence the body. For this reason they have been called "dependent" facts. When the body is taken away they disappear. But the form, growth, and history of the tree have such an independent existence. They are taken to be facts about objects of nature; while *my seeing* of the tree, *my hearing* of the wind among the leaves, *my fear* that the tree may die, and *my discovery* that the tree is an elm are mat-

ters of experience which are bound in a peculiar and unique way to physiological processes which run their course within my body. And, moreover, whether experience refers to "outside" objects, or to the state of my internal organs, or to the destiny of the human race, or to the slow passage of time, or to the uneasy conviction that I have wronged my neighbor, there is always implied the body; for with the cessation of those physiological operations of which we have spoken experience ceases to exist. Again this experience always *proceeds;* it never simply *is.* It is, therefore, unlike the stone or the star which may indefinitely endure. When it is regarded as simply going on, as a panoramic proceeding, its stages and phases are said to have a "phenomenal" existence. That means that we regard their going and coming, their mere appearing and disappearing, and not any of the fixed objects or the physical details of the world with which experience may acquaint us.

The phenomenal items which make up our immediate and fluent experiences, then, sustain the most intimate relations with processes within the nervous system, the muscles, the viscera, and the glands. We normally experience tastes only when sapid substances reach those pits and furrows upon the tongue and adjoining regions which conceal the minute "taste buds." When these organs are damaged or when the gustatory nerves are cut or atrophied, taste disappears. So the ear initiates sounds, the eye colors, and the neural twigs and skeins within the cutaneous body-covering touch and temperature. A blow upon the head or a few whiffs of ether may terminate all experience. Diseases of the brain lead to insanity. Early deformities of the head sometimes result in imbecility and the enfeeblement of mind. The toxins of fatigue and the exhaustion of hunger disturb clear thinking, and disorders of the heart have been known to produce grave emotions of fear and apprehension. Bad dreams, even ghosts, have a traditional dependence upon the processes of digestion. "There is more of gravy than of grave about you," exclaimed Scrooge to the apparition of Marley. In so many ways has this intimate dependence of experience upon bodily processes been demonstrated, time after time, that we all accept it as a matter of course.

But let us be perfectly clear about one thing. "Intimate dependence" does not mean identity. A purple color or a salty taste is no more a part of the eye or the tongue, and it is no more like the eye or the tongue, than the speed of the bullet is a part of, or is like, the rifle. Color and taste, pressure and unpleasantness, tone and noise, are ultimately and fundamentally unlike any part or any process of the body. When we are occupied with these processes of experience, our reference to the body will be a reference only to the bodily conditions and antecedents of them. We cannot neglect this sort of reference, for the discovery of conditions and antecedents is a very important part of all the sciences. The person who would know and understand experience—and this is the primary object of the psychologist—must both discover and describe just as accurately as he can this fundamental relation between experience and the body. It is one of the things which serve to distinguish his task from the tasks of the zoölogist, the astronomer, the chemist and the geologist.

Finally, we have to return to our declaration that a large part of the material which fills the books on psychology and which furnishes the laboratories with new problems of research are directly related neither to the individual items analyzed out of experience, nor to the organization of these, nor to the dependence of experience upon the body. It concerns instead the *psychosomatic functions*. This is the general topic of Part III, which gives the account of those operations of the total organism in which mental and physical resources are functionally conjoined for the carrying through of perception, memory, action, thought, and the like.

By turning again to our first collection of raw materials we shall come upon several good instances of these psychosomatic functions. For example, the variation in speed of the motor car is the expression of one type, the executive or actional type. The conditions sustaining the control of wheel and brake are in part mental (*e.g.*, resolves and moods), and in part physical (eye, hand, and the innervation of appropriate muscles). The tongue's discovery of a new dental cavity illustrates another type of these functions, the ap-

prehensive type. The hollow tooth is apprehended or perceived. The perception of the huge hole is an operation at once mental and physical. The pressure sensations and the visual image which mean "a large cavity" are mental; the manipulations of the tongue are physical.

The functional operations here illustrated have had a curious history in psychology. Sometimes they have been set down as "active" and "passive powers" or "faculties" of the mind or of the "soul," phrases which have a substantial sound but little concrete meaning; at times they have been called "mental functions"; again psychologists have been content with an analysis into "mental processes" and have left the functional or operative part out of account; and of late the more biological writers have referred to them as bits of "behavior" designed to adjust the organism to its surroundings.

Now "power" and "faculty" when applied to mind, are—as we have contended—empty words; they seem to explain, but they do not; analysis is the first necessary step, but it leaves out of account the aspect of performance; "mental function" implicitly accords to mind attributes which it does not independently possess; and "behavior" is a concept of biology which either leaves experience altogether out of account or else admits it only for the service which it can render to life. As a matter of hard fact, again, what we actually find in all of these "functional" occurrences is the coöperation of mind and body in a performance, an accomplishment. What is *done*—whether the performance is memory, perception, action, thought, or emotion—is done by the joint agency of mind and body, by the exercise of the psychosomatic functions. Let us leave aside, then, such speculative questions as the independent "activity" of mind, "mental energy," and the concept of "mental causation." When we follow through an action or a perception or an emotion we invariably find that the factors in it are *mind-body* factors and these factors we cannot dispel by argument. If we regard the facts as they stand, without trying to modify them by speculation into this or that favorite doctrine, we shall be able to dispose in a satisfactory way of a large body of factual material which obviously belongs to the province of the psychologist.

A frank admission of acts and functions will lead us in time directly beyond the group of phenomena which we have

just now discussed and toward the *limits* of function. Here again we shall not speak of "mental" capacity. Since all activity and all function are psychosomatic, it follows that the limits of function are matters of the same order. The mind-body remembers just so-and-so much after ten, fifteen, or twenty repetitions; the mind-body extends its functional limits under practice and habituation; the mind-body learns; the mind-body acts; it sets the limitations to the "self" and gives to individuality its shadings and its varieties.

Psychology first includes, then, the products of inspective analysis, the individual qualities which are alone the substantive parts of mind. They *are* mind when mind is regarded on the side of composition. Observation reveals no other kind of mental existence. Other "minds" which have been proposed are either the creations of magic, the products of speculation, or abstractions from the concrete facts. Even "intelligence," the "unconscious," and other popular conceptions of the day spring, as we shall finally see, from one or another of these non-observational sources. But of equal importance to psychology is the integrative aspect; mind in its organized state, the qualities of experience viewed in a synthetic, instead of an analytic, way. And finally, as a third fundamental problem, stand the operations of mind-body; perception, memory, thinking, imagination, action, and the rest. These operations include all the primary psychosomatic functions of the total or psychological organism, the *psychosome.*

This basal treatment of the psychological organism must be supplemented by certain special aspects of experience. Most important for a survey are socialization and development. As for the former we start with the observation that the organism lives among its kind, and that this congregate living leads to socialization. The terms and conditions of socialization must be regarded as well as the psychological groupings which are its immediate expression. The key to

socialization we shall find in the psychosomatic functions; for it is by means of these fundamental operations displayed in action, perception, emotion, etc., that the individual maintains his place in congregate living.

The total organism or psychosome is not made in a day. Its developmental history is engraved within it. Within a survey of the field of psychology, therefore, we should find a place both for the evolutionary history of the psychosome among animal forms and for those progressive or genetic changes under which the human individual is formed between birth and adulthood.

PART I

THE COMPOSITION OF EXPERIENCE

CHAPTER II

ANALYSIS AND THE PRODUCTS OF ANALYSIS

The Psychologist's Method of Analysis

Our first approach has made it obvious that we cannot simply select certain interesting facts from everyday life and label them "psychological." The growth of coherent and accurate knowledge does not anywhere come from the mere assorting of human experiences in order that one experience may be delivered at the door of physics, another sent to the biologist, a third consigned to the psychologist, and so on, until the whole lot is exhausted. Instead, all of the descriptive sciences draw from a common fund, each using its own method, and each extracting and distilling its own products. The products of the physicist fall under the headings or categories of space-time, mass and electric charge; those of the chemist (if we may distinguish his problems from those of physics) under atomic composition, molecular constitution, and the like; and those of the biologist under such schemes of classification as reproduction, growth, metabolism, form, and environmental interplay. In a similar way, we must succeed in defining both the mode in which the psychologist extracts and refines his materials and the proper categories for describing and studying them, once they are extracted.

There is one important point at which the psychologist's concern with experience differs from that of all the other sciences. The objects and events of physics and of the rest are regarded *as if they outlasted the experiencing of them and continued as independent of the act of apprehension.* We should not know of movements in the magnetic field or

of loss of mass under friction save by concrete experiences of the observational kind, and we should not construct plans of the solar system or conceive the nature of the atom save by experiences of the imaginational and thinking kind; but once we have our physical facts and our physical hypotheses, laid down in the terms and the categories just now suggested, these physical constructions are then regarded as if they were free and independent of the experiences in which they were discovered—by way of which, in a sense, they originated. This freeing of objects, laws, and principles from the active experiencing in which they appear to the perceiving and reflecting observer is found in each and every branch of the physical and biological sciences. Animals, the earth's strata, the ocean's substance, the planet's course, and the electron's oscillations are one and all regarded as if ordered, arranged, and preserved in existence wholly apart from the experiencing organism which discerns them. But what shall we say of the objects and the operations of the psychologist? We shall say of these that they *are* only when they are-in-experience. For their existence the organism must be at hand and it must be intact. A whiff of nitrous oxide, a blow upon the head, the stoppage of a blood vessel, and they are gone. Experience then ceases. It is bound to the functionating body. We cannot of course say that it is unreal just because it is evanescent or because it is dependent. We could scarcely admit the actuality and the substance of things and theories acquired through experience and at the same time deny the actuality and the substance of the experience itself. Indeed, the very tissue of physical existence seems to hang upon that character of experience which we may call the "objectifying attitude." So readily does the organism assume this attitude, making experience transform parts of itself into enduring stone, growing tree, and swinging planet, that we find it difficult to shift from the attitude, to break up the "set" of permanence and of "objectness," and to return to the fluent

and immediate course of experience itself. But this shift is the very thing implied in the psychologist's view of existence. Let us see what facts it brings forth for study.

Long ago the psychologist's attitude brought forth, as we have already observed it in its cruder and grosser forms, the conception of an activity lodged *in* the organism but not *of* it; an activity expressing itself in the "thinking," "willing," and "understanding" faculties of the older psychologies. With these faculties we have already settled our accounts, discovering that in place of them we must substitute, if our subject is to be an empirical and descriptive science, something concrete and actual. In place of these empty faculties we begin, then, with the conception of experience as related to the total organism, the organism which is at once physical and mental and which produces experience only by virtue of its coöperative functions of the psychosomatic kind.

If we are to factor these functions and so to arrive at the several resources upon which the organism draws, we must separately observe those parts which are physical and those which are mental or non-physical. To the psychologist the mental factors stand first. He alone is responsible for their description. But since they display a fixed and significant relation to bodily organs and bodily processes, the psychologist may be constantly guided and directed toward them by the general architecture and the functional plan of the body. In studying this plan, as an aid to his description of experience, he soon discovers a simple, direct and striking correspondence between certain items in experience and local forces which impinge upon the body. In experience, for example, appear tones and noises; and as they appear the organism is affected in a specific way and at a particular place by vibratory movements of the air. These vibratory movements (a part of the physicist's world) affect experience only by way of the ear; more exactly stated, by way of the auditory receptor or sense organ in the inner ear. A

like correspondence obtains between the lights and colors of experience and the stimulation of visual receptors in the retina; between "felt" cold and organs scattered here and there throughout the skin, and so on for many other individual items. Here, then, is a concrete means of approach to the mental resources of the organism. Factual bits of experience lead, when they are separated out and considered just by themselves, to the observation of fixed relations between the organism and the forces and agents which surround it. Our first large task is to see what relevant facts may be derived by this means.

It must already be clear to you that this way of approach is the analytical way. Instead of taking an entire experience as it comes, an experience too complicated and too rapid for observation, we take out of it bit by bit single items, which are to be treated as exhaustively as possible until we know their properties or "dimensions" as well as the various ways in which they stand related to other similar items. Analysis is the initial step in all scientific inquiry. Nature never displays a single, simple, isolated object. Objects are themselves complex and they appear in a context made up of other objects. Chemical substances are generally found in combination; sunlight is compounded of a great number of wave trains of varying lengths, plants and animals are vast colonies of cells or of minuter structures, and each cell or part itself contains many intricate compounds. Experience, too—when we depart from the detached and dependent worlds of our common knowledge and of our physical science—shows a complexity which is just as great and just as embarrassing to description.

Now let us be sure of exactly what we are analyzing, when we set out to factor experience. Man's inveterate bias toward *independent* things and events we have remarked; the bias which has brought the physical sciences early and left the study of dependent experience, the great fountain source of

all knowledge, in a neglected state. It requires special "art and pains," as Locke long ago observed, to shut out the "manufactured" world of things and to inspect the medium of experience itself. When we proceed to the examination of our tones and noises, then; of our lights, colors, colds, warmths, sweets, sours, and the like, we must take care that we do not slip from *experiencing* to the things *experienced,* to noisy cities, to tuneful voices, to sunlight and shadows, to the chill of the night, the warmth of the noon, and so on to the other *independent objects.* We must instead study noise as a passing "noisiness," color as the blueness, redness, or grayness which comes into existence when we open our eyes and departs when our eyes are closed; cold as that sharp biting quality which no amount of examination of the physical properties of ice and snow could teach us were we devoid of the temperature receptors set mosaic-wise in the integument of our bodies.

Right and Wrong Procedures

We come to terms, therefore, upon the correct method of analyzing experience. "There are a thousand ways to anywhere," runs an Arabian proverb, "but only one will serve." In the history of psychology a good many attempts at analysis have taken a wrong course. To come to the most pernicious of these we pass over the reduction of experience (common also in the layman's way of thinking about himself) to the faculties or powers of "knowing," "willing," and "understanding," to the "mental organs" of the phrenologists, and to the stereotyped bits of knowledge which the traditional English psychologists called "impressions" and "ideas."

1. One of the most serious historical mistakes in psychological analysis has arisen from the confusion of experience with the physical objects which are perceived "through the senses." A red book with yellow lettering stands before me,

at this moment, on my desk. When I say that this book is made of wine colored covers, white leaves with black printing, and large yellow letters upon the back, it is obvious that I am analyzing the book—not the experience which underlies the perception of the book. And when I say that I listened last night to an orchestra composed of violins, 'cellos, double basses, wood-winds, brasses, and the rest, it is obvious that I am attempting a rough analytic description of the orchestra and not of anything connected with my organism. It scarcely seems possible that such things as books and violins should be mistaken for the furnishings of mind; but this is precisely the first error that the beginner drops into in his quest for component qualities. The first thing to guard against, therefore, in psychological analysis is the picking to pieces of objects perceived, with the mistaken idea that you are analyzing as the psychologist properly analyzes. If you wish to describe in terms of color, you have to leave out of account the texture and the parts of the book and you have to consider only *redness,* which comes into existence the moment you turn your eyes to the book, changes under adaptation as you look, and goes again out of existence soon after you turn your eyes away. This redness is not the red dye of the book, which you regard as a relatively permanent part of the volume. It is referable to the total psychosomatic organism, not to the book. If it were a part of the book, you would classify it as one of the red books or as a particular kind of dye. You do classify it, as a psychologist, not with the books or with the dyes; you put it in its place in the whole series of color qualities as represented, say, in the color pyramid (Chapter iii). The "red" becomes thus no less a matter of direct and immediate observation than it would be if you were classifying books or dyes with respect to color. It is only for you at this time a newer and less accustomed way than the other ways. Let me renew the caution, then. Just so soon as you find that you are

regarding your object either as something which has a permanent existence or which is a part of a physical object, so soon you may be certain that you have not brought under your observation a mental object at all, but instead something which belongs to another order of existence. On the contrary, when you find that your observed object is so described that it takes its place in a mental order or a mental series (*e.g.*, the color "sensations"), then you may know that the object belongs to the realm of the psychologist

This confusion of physical objects with mental phenomena is not so surprising as it at first appears. The various physical sciences take the observing organism for granted. Eyes, ears, brain, and "sensations" are to the chemist, the geologist, and the astronomer, just necessary means for the observation of the reagent, the outcrop, or the star. They thus belong, as means, with the retort, the hammer, and the telescope. The observer in the physical science makes sure that he himself is trained and equipped and that his instruments are standardized. Both must be adequate and reliable. But when the facts observed pertain, as they do in psychology, to the organism itself, "foreign objects" become only meaning or "reference." They are cut off from the experiencing organism which perceives, remembers and thinks them. Stated in other words, the star, for example, is to the astronomer an object from which appropriate facts and principles can be derived; but to the psychologist the star is a meaning which certain light and color qualities bear. Since the psychologist is not concerned with stars, but with the organism, he abstracts from the astronomer's object (for him irrelevant) and finds light and color "sensations" of describable quality, intensity, duration, and other attributes. The meaning, intent, reference-beyond-the-organism is thus eliminated.

2. A still commoner mistake in the analysis of mental phenomena is to lay hold of any object which is thought about, or remembered, or imagined and to analyze that object with the confused notion that the observer is analyzing "mental processes." "I may, for example," says the author of a recent *Introduction to Psychology,* "in my mind's eye see

myself walking to my office." The seeing "in the mind's eye" is given as an instance of "trained scientific introspection." But a moment's reflection will make it obvious to the reader that "myself imagined as walking" or "myself remembered as walking" is just as much an object of the physical order as "myself now perceived as walking."[1] The essential difference is a difference in tense; not a difference between physical objects and mental objects. We all do say in the vernacular that an object which we remember or think about is only a "mental object"; but there we only mean that the object is not at the moment present to the senses. It is no more "mental" than the book now in your hand is mental. It is an object, and an object no less because you refer it to the world of memory or of phantasy, instead of to the place where you can lay your hand on it. This whole question we shall consider again, from a different direction, when we come to deal with the functional aspects of the organism.

3. A third way in which the psychologist's observation and analysis are misconceived is the "bodily" way. Many persons think that, when they announce such an interesting fact as palpitation and trembling in sudden fear or the dryness of the throat in continued thirst, they have observed and reported psychologically. They are mistaken. This is one of the nine hundred and ninety-nine *wrong* ways of analysis! It might be called the behaviorist's way of all flesh and no mind. Again, you may set it down as an invariable rule that any event that is described as running its course in some part of the body is not a mental event. It may imply mental phenomena, it does not describe them. There the fact of private possession causes confusion—a confusion which is fostered by some careless writers who still speak of the

[1] "The image of a tree is no more examined by introspection than the perceived tree. Both are objects of extrospection." S. Alexander, *Space, Time and Deity* (1920), Chap. ii, p. 90.

observation of mind as "self observation." The palpitation and the dryness seem to belong to *me*. But although they may come to be known through processes of experience (a group of pressures of alternating intensities, in the one case; a complex of warmth and dull massive pressure, in the other), the palpitation and the dryness are no more mental than the heart and the throat themselves are mental. To defend yourself against this new temptation to confuse striking bodily experiences with psychological description, remember that mental facts, when regarded and described as such, never, under any circumstances, display the attributes of the body, which is as much an object beyond and "outside" experience as the tree or the star is. Tones would be the same "singing," high and low, strong and weak, short and long things that they actually are, if we had never discovered that they somehow depend upon the integrity of the ear. So also colors and grays. The bodily organs are only *conditions*, not parts or aspects or properties, of the experiential qualities.

4. To complete our list of cautions against the wrong methods of observation and analysis, we must touch upon one further source of confusion. In making a personal reference to any sort of interesting event in which they have played a part, many individuals believe that they are describing introspectively, *i.e.*, giving an account of their "mental processes." Familiar references of this kind are: "I was filled with embarrassment when I was asked without warning to speak," "My whole mind was full of the desire to answer the impertinent charge," and "I experienced the sensation of living in one moment through the events of a lifetime." Now in such statements as these there is an intimation of a sort that mind is involved in the events described —an emotion, a desire, a curious experience of hurried time. The point is that they are *intimations, indications*, literally a pointing of the index finger toward, but *not descriptions*.

It is as if an aërial observer should report upon descending that he looked down and saw the earth, instead of bringing down photographs or writing out exact topographical descriptions. He intimates that he observed; he does not describe the objects of his observations. Psychology—and not only the popular psychology of magazines and of the street corner—serious psychology abounds in these spurious introspections which have absolutely no value in a descriptive account of mental composition.

Consider an instance from the laboratory itself. You are seated in a black, lightless room looking straight ahead into the darkness when suddenly a brilliant light is flashed upon your eyes. Afterward, in rehearsing the experience, you recite the fact that you were for an instant blinded; that the flash startled you; that then you seemed to be groping in heavy darkness in which you presently noticed a patch of greenish color which seemed to float against the blackness until it presently moved off slowly toward the upper, left-hand corner of the room. Here we have a refinement of the method of intimation which we have been discussing. You have told several things that happened to you in the dark room; you have not given one iota of scientific description of the visual qualities themselves. After a little practice, you will be able to recognize these spurious inspections; for you will see that they do not contain the mental materials which you will find enumerated and classified in the following chapters. However useful we may later find these intimations to be, when we come to regard mind from points of view other than the descriptive and the analytic, we must insist that they have absolutely no value as *inspections,* a word which we shall jealously guard and carefully reserve for the observation of mental facts only. Within psychology itself, the error which we have just now described is commonly known as the error of "information," because the intimations and suggestions which are given in these cases are always given by way of *information* instead of in description; information in the sense that the speaker *informs* you that such and such things occurred, instead of giving you in psychological terms the mental factors involved in the experience. He tells you that he *went through* a given experience or witnessed a given event, *e.g.,* "I saw the entire tennis match," "I heard every one of the sym-

phonic concerts"—instead of reproducing in descriptive terms exactly what happened. To give one more instance of a somewhat different sort of intimation, it is as if a boy returned from the circus only to relate that "the thing opened at three o'clock, was set up in marshy ground, and carried its animals upon a special train." All of this is *information about* the circus; but it does not include one word of description of the actual performance.

This information, which appears in the observer's report, falls under our method of the *commentary,* a method coördinate with mental inspection. We apply the term "commentary" because the report consists of "comments" made by the observer upon the course of the experiment. It has only a secondary use in psychological analysis. It frequently informs the experimenter upon the way in which the observer is adjusting himself to the conditions imposed. To observe that the click of a shutter annoys or distracts, or that the observer is searching for stray significances in the nonsense syllables may be of first-rate importance to the progress of the experiment. But it includes no descriptive account in terms of quality or other attribute. When we come to treat the organism in a *functional* way (Part III) we shall see that this method of the commentary is one of the chief resources of the psychologist. Here we note it only that we may avoid a substitution of the commentary for the genuine inspection.

After this long recita., which has taken time and pains—if it has not exacted of you the double fee of Timotheus—you will be persuaded both that the popular psychology which we live in and breathe is vicious and that a true analytic observation is difficult. Both convictions are well based. Popular psychology *has* no interest in the scientific description of mind; and the method of inspection *is* difficult in the sense that it requires training and technical knowledge. As regards these requirements, however, all the sciences share

them. No one would be able to describe the protozoa who knew only how to mount specimens, to place the slide upon the microscope, and to adjust the focus. The protozoölogist must be able to recognize Paramecium bursaria, Euglena viridens, Colpidium, Coleps hirtus, and Amoeba proteus; he must be able to distinguish ciliates, flagellates, and rhizopods; he must know the classes sarcodina, mastigophora, sporozoa, and infusoria; and he must be familiar with the internal structure, metabolism, and history of the general group of unicellular organisms. No one can claim to be a telegrapher simply because he can hear clicks in the receiving room. Each subject speaks its own language, has its own point of view, its own terms and rubrics, its own technique, its own problems, and its peculiar principles of explanation.

Observation, Inspection and Experiment: Quality and Stimulus

It should be clear that the method which psychologists employ in searching out and analyzing experience is the *method of observation.* Observation means here just what it means in the other descriptive sciences; namely, (1) the careful noting of some property, attribute, or occurrence from a definite point of view and with a definite purpose, and (2) the formulation in words or other symbols, accepted by the science, of what is noted. That is to say, an observation includes both the first-hand inspection and the technical report of the inspection. It is less the nature of the observation than the setting in which it is placed that makes it a psychological rather than a physical or a physiological or a zoölogical observation. To the analytical psychologist any experience which is inspected is inspected from the psychological point of view, *i.e.,* it is looked upon as a bit of experience, which is to be described in terms of its simpler components. Already we have considered a good many illustrations of the sort of material yielded by this inspection.

Take an instance which involves the functions of the eye. Where the anatomist observes a network of cells, the chemist a reaction in the test tube, and the geologist evidences of erosion, the psychologist observes visual qualities of light and color. In *his* terms, all experiences which immediately rest upon the eye are reducible to these two large groups of elementary facts. Again, where the musical theorist observes the construction of harmonies and melodies or where the passerby hears economic principles proclaimed from the street corner, the psychologist observes qualities of tone and noise. By way of generalization, we may say again that each observer selects from a given experience the materials which are appropriate to his own science or to his interest of the moment. These materials he reports in the terms of a particular science or of his passing interest. When once we know what the properties and the peculiarities of our psychological objects are, we then observe these things just as directly and just as easily and naturally as the chemist observes the effect of hydrochloric acid upon marble or as the neurologist observes the medullary sheath of a nerve fiber. The common name for the psychologist's inspection, namely, "introspection," is unfortunate, since it suggests that the psychologist breaks open a kind of magic box and peers within. Nothing of the kind. He has not attained, as many persons think, the desire of the sentimental heroine of the novel who longed for a pair of the adjustable eyes of a doll that she might turn her vision inward and scrutinize her thrilling soul. Once the beginner realizes that his ambition to get a bird's-eye view of mind-in-general is just as foolish as an ambition to see life-in-general or force-in-general would be, just so soon should he be content to settle down to the study of concrete experience. Always does the science learn first the particular aspects of things and only later does it compare and classify and generalize.

A good deal has been said and written about "introspec-

tion" as if it were a method in psychology coördinate with observation, and of experiment as if it were a third sort of way of getting at the facts. This view is mistaken. Where we are confronted with the task of inspecting and describing mind as a totality, our only primary method is the kind of inspection and report which we have spoken of now as "observation" and again as "introspection." Both terms are appropriate. The word "introspection" has been subjected to so many bad uses that it stands in need of careful definition; but when it is taken to mean just the observation of a single aspect of experience it loses its sinister and doubtful signification. To avoid the bad connotations, however, we shall use, by preference, the term *psychological inspection* or simply *inspection.* But we must remember that observation includes also the *commentary*—a method common to the physical and the biological sciences—as well as the *inspection.* The word "experiment" will give no difficulty to those who have worked in any of the sciences of nature. It only provides for observation its most favorable conditions. It includes, besides the observation, its setting. It is simply an arrangement, usually involving apparatus, which makes it convenient to inspect or to comment upon the object under scrutiny in various contexts, at different times, and with many observers. It also frequently facilitates and refines the report of the observer and so reduces the chance of error from the cumbrous use of language. Suppose that we wish to determine the smallest difference in pitch that is discernible. Our experimental conditions will provide us with two tones of near lying but variable pitch and they will also make it possible to report—say, by the pressure of an electrical key—simply "the same" or "different"; instead of saying "that is a mite higher than this" or "the two tones are distinctly unlike." An experiment in psychology is, then, simply a controlled and verifiable observation. It stands to reason that the more experiment can be used here, as in the

other sciences, the fuller and more accurate will our knowledge be. It also follows that those problems which have been submitted by the psychologist to experimental test will be found to be, other things equal, nearest solution. Experiment is therefore an exceedingly useful tool in psychology; but it never takes the place of observation in analysis and description.

One special advantage of experiment in psychology is that it controls and varies the matter under investigation by its control and variation of the physical conditions which act upon the organism and so ultimately produce the object inspected. These conditions usually take the form of some physical or chemical agent which acts upon the receptor organ, the organ of sense. There the physical agent is known as the *stimulus*. Thus, in our case of the similar tones, the stimulus is a vibratory movement of given length, amplitude and form. The stimulus is to be described in the standard terms of physics or chemistry; never in terms either of the mental process (in this case, the higher or the lower tone), and never in terms of the object which the observer perceives. It would be wrong, therefore, to speak of the tone as the stimulus and just as wrong to call the tuning fork (the object perceived) the stimulus. Stimulus is always, then, to be described in physical terms. As for "process" itself, the term only indicates the fact that experience is always fluent; that it is always, as we have observed, in course; never static and simply enduring without change. When we are directly inspecting and reporting experience, then, we are safe in referring to it as "process-like" or as "processual." This designation helps us to distinguish it from the fixed objects beyond experience, which are regarded as independent. But "process" contains no intimation that the items found in experience run their course in some mysterious substance such as the "self" or a "personality." In view of the magical connotations of the words "mind" and

"mental," it might be better if we did not find it necessary to use them in designating experience. There is, however, an advantage in using words for experience which do not suggest the physical order of existence. So we shall speak of experience at large as "mind" and of the dimensions and attributes of experience as "mental" dimensions and attributes.

The Products of Analysis

Now experiences always come as connected and integrated wholes. They are never atomic; never strung along like separate beads upon a string. Experience is organic, integral. All attempts to analyze it must take this condition into account. To break up the integrated tissue of experience is to destroy its continuity and its consolidated character. To stop the film for the examination of the separate exposures is to interfere with the depiction. At the same time, analysis is necessary, as we have said, in order to acquire a knowledge of experience on the side of composition. And unless we first analyze we cannot later understand the whole configuration.

When we observed the dependence of experience upon the body, in details as well as in the aggregate, we found our first clew to analysis. In the flux of experience we discover individual qualities, *e.g.*, tones, noises, color, cold and warmth, which run their courses parallel to the action of stimulus upon the diverse receptors or receiving organs annexed to the nervous system. These individual qualities we can isolate, inspect, compare, and classify. Moreover, we can discover their exact relation of dependence upon the stimulus. That is the double problem of "sensation." Sensational quality is a part of the raw stuff from which the tissue of experience is made. It is not experience, in the sense that the individual cells of the wall-layers of the stomach are not the stomach. But the withdrawal of the whole class of these

qualities would immeasurably impoverish experience and thereby embarrass it in its offices.

Besides the qualities of sensation, which present variations in intensity, duration, richness, clearness, and so on, the psychologist also discovers qualities which are not dependent, as these qualities are, upon stimulus. The tone may, on occasion, "sing" with the ears stopped and the red may appear with the eyes closed. Whole sonatas and entire panoramas may be presented upon the basis of something which wears the aspect of "echoes" of sensation. We "image," as we say, the face lately seen or the voice which we conjecture to belong to an unknown correspondent. The image itself is, to be sure, something beyond the mere experiencing; for it is, after all, a face or a voice. Nevertheless, the raw stuff of the image is of the same general kind as the sensations. In fact, no unequivocal and thoroughgoing difference, save one of shading or nuance, has been made out between the two classes. For the sake of convenience, we may speak of these latter items as *sensimages*. This term points to the close qualitative likeness with sensation and, at the same time, it avoids the troublesome reference beyond experience (as to the "face" and to the "voice") which clings to the word "image." We shall speak, then, as we analyze experience, of auditory, visual, tactual, and thermal sensimages just as we shall speak of the similar qualities of sensation. Whether the two groups are of exactly the same range and exactly correspond, quality for quality, we shall leave to the sequel in the next-following chapter.

But sensation and sensimage do not exhaust experience. There is also the affective or "feeling" aspect, which is not reducible to these two groups. What can we say of this aspect? To understand the affective component of experience we must consider that the dependence upon the living organism refers not only to receptor functions (in the case of sensations) and to similar functions initiated in the brain

(in the case of sensimages). The dependence is also upon the *general trend of life* throughout the body; upon metabolic tides and currents, upon various ways in which the total body is functionally disposed. Thus a sluggish digestion, a quickened pulse, a shift of arterial pressure, or a decline in the available supply of oxygen may mean a general tempering of the organic functions. It is impossible that these accelerations and retardations, these moments of high tide and low tide, excess or deficiency in nutritive materials, should succeed each other without impressing general changes of state upon the central nervous system, the most highly integrative of all the great systems of the body. And it appears to be just in feelings, moods, drives toward heightened activity, and dull moments of inertness that this aspect of dependency especially enters experience. Experience thus stands as a gauge or indicator of the levels, accelerations and modes of life. Here we have to proceed with special caution in our analytic methods. During those experiences which we call "emotional," "passionate" and "stirring," the indicatory phase is prominent but not exclusive. Here we "feel"; here life suddenly inclines this way or that. But here also experience is dramatic and depictive, for sensations and sensimages are woven into textures or configurations which mean "the fearful scene," "the object of passionate desire," "pitiful want," or "the triumphant enemy." The emotion and other like settings are then both pictorial and affective. In our *moods,* however, the gauge of life rises and falls with less complication. And in the still simpler feelings this indicatory aspect appears in yet purer form.

We speak of "analyzing" feelings; but what we really do is to separate the pattern or configurational side of experience, composed of sensations and sensimages, from the other, the indicatory side, which is of a wholly different character. We shall hardly place the pure feelings, therefore, alongside the two sensational classes as a third class of the same genus.

The *feeling* appears not as an "item" in experience but as coloring or shading. It is akin to the varnish or sizing upon the painting, the mist upon the valley, and the haze upon the distant mountain. Although it does not directly contribute to what we may call the "outside references" of experience, giving us objects and knowledge and a spatial-temporal theater in which the physical order is presented, it does give warmth and value; it gives—so to say—the barometric changes of life. In a word, it supplies "weather." Since pure feeling is never a mosaic but always a suffusion, we shall not expect to discover parts or members in it. Instead we shall hope to read its scale, determine its "saturation" and its range, and, finally, inquire whether, beside its rise and fall, it likewise presents qualitative varieties in accord with the variable manner in which life shifts from day to day and from moment to moment.[2]

[2] This view of feeling would seem to preserve the essential features of various doctrines which have laid emphasis upon the "subjectivity" of feeling, upon its close relation to "value" and to attention, upon its want of "clearness" and upon its "adaptive" or other biological significance.

CHAPTER III

THE CONSTITUENTS OF EXPERIENCE

I. The Sensational Qualities

The Psychologist's Use of "Sensation"

Like the variegated world about us, experience is complex. It is complex both in its temporal course and in its momentary phases. Even our gross and uncontrolled observation of what is constantly coming and going in desire, perception, and memory reveals this double complexity.

Now the complex is always difficult to know. It resists accurate description. In our uncritical view of mind and experience, to be sure, we make short work of the difficulty. There we assume or we take on trust from our elders a single unitary and permanent being, the "mind," "soul," "self," or "person"; we grant it powers of perception, desire, memory, and the rest, and behold, everything is accounted for! But that is precisely like accounting for recurrent sunrises by Phœbus and his glowing chariot or for the weight and movement of the planets by innumerable fingers stretched outward by a clutching monster hidden within the sun.

But the natural sciences proceed otherwise to their descriptions. They first distinguish the essential aspects or properties of the object which they are to study and then they go on by abstraction to describe these aspects and properties in appropriate terms. Physical substances have many characteristics, as mass, specific gravity, boiling point, friability, valence, and the like; wave motion has period, length,

and form, and the electric current has magnitude and tension. So likewise psychology proceeds. Experience reveals a qualitative variety. Accordingly the psychologist specifies in terms of quality. He finds in his experience blues, greens, grays, high tones, thudding noises, bitter, salt, pressure, pain and so on. He also finds that each quality stands at a given *intensity,* weak, moderate, or intense, appears with a definable degree of *clearness,* and endures through time. These aspects, properties or peculiarities of experience are what the psychologist observes when he inspects (or "introspects," taking the term *senso stricto*). He never observes a total sensation or sensimage or thought. An observed quality is sometimes called a "sensation"; but to speak accurately we should always regard the sensation as a logical construction which puts together all the observable simple aspects of a bit of experience. These logical constructions are useful, however, both because they are depositories of our analytical knowledge of experience and because they stand in fixed and definable relations to certain organs and processes of the body.

The Sensational Qualities in Experience

When a tuning fork is struck, or a colored light flashed on the screen, or a solution of quinine brushed over the tongue, a given quality, tonal, visual, or gustatory, is observable. The psychological observer, set to inspect quality-wise, reports what the quality is and how it stands related to other similar qualities. In doing this he abstracts from all the characteristics of physical objects and of his own body, regarding the quality only as an immediately given aspect of the visual, auditory or taste experience. Again, instead of a single quality, he may observe two, reporting that one purple is more like a standard blue than the other or one tonal quality graver than the other tone; or once more, he may observe an entire series of colors, reporting an even

rate of continuous change, say, from yellow to red. We have now to gather together the combined results of thousands and thousands of such inspections and reports, and to give a brief systematic arrangement of all those simple qualities of experience (sensational qualities), which rest directly upon the receptor organs.

A. *Visual Qualities*

After our critique of analytic observation in the last chapter, it will be obvious that the visual qualities do not include either the painter's pigments (the artist's means of coloring a surface) or processes in the eye (the physiologist's processes) or wave length and amplitude (the physicist's description of light). They include only such things as "redness," "lightness" and "richness," which point to immediately given aspects of experience without regard to objects or to bodily conditions. We go on, then, to describe and to classify the whole number of these visual qualities. The nature of visual experience makes our task relatively easy. All visual qualities display a striking kinship, they all belong in one natural class; so we have only to distinguish, to identify, and to arrange them.

First, they fall into two large sub-groups; light qualities and color qualities. The first group contains all the whites, grays, and blacks; the second all that remain, *i.e.,* the yellows, blues, purples, reds, violets, olives, greens, mauves, and the rest, of every degree of lightness and darkness, and every degree of "richness" and "thinness." The first group may contain less than 1,000 different qualities, and the second well over 30,000.

The relationships of the "light" group—of the gray-series," as it is sometimes called—are perfectly simple and unequivocal. If you were to cut out twenty-five small squares of artist's canvas and to cover each with different relative amounts of white and black paint, you would find

when you were done that you could arrange these squares in just one way to represent the natural relations of the blacks, whites and grays which you had painted. This order would give you the whitest white at one end, the blackest black at the other, and the grays (light, medium, and dark) falling between, with the smallest differences represented by neighboring pairs. This order is the *psychological* order of the light qualities. Within it every quality has its own unique place between its nearest neighbors on the right and on the left. You would probably have found that your "gray" paints produced some yellowish grays and some bluish grays and that, in order to make these squares fit properly into your light-series, you were obliged to add now "blue" pigment and now "yellow" pigment to, say, Chinese white and lampblack. You would have found, also, that you had to add *more* Chinese white to the lampblack at one part of the series than at another in order to produce even steps between the grays. These discrepancies, then, between your final gray series and the means used to produce it will serve to convince you that what you have at the end is not a pigmental series, not a graduated physical series of any sort, but a series of qualities which reveals a gradual change in a constant direction (black to white or white to black), and a constant degree of qualitative difference between neighboring members.

This kind of series is known as a one-dimensional series because it can be represented by a straight line. The ends of the series fall at the two ends of the line and the intermediate qualities fall each at its appropriate place somewhere between.[1] Figure 1 represents the series.

Whites
Grayish whites
Lightish grays
Middle grays
Darkish grays
Grayish blacks
Blacks

FIG. 1

[1] The entire series is never experienced with a single illumination. All illuminations, from the weakest to the strongest, as well as all

When we turn to the color series we discover that we have not only vastly more qualities to deal with, but that these qualities refuse to be ordered in such a simple manner as the grays or lights. Nevertheless the order is there and we have only to inspect it, as psychologists, to bring it out. Suppose that you were to increase your canvas squares to a hundred and your paints to, say, twenty pigments in oil well chosen to produce the various colors. If then you sat down for a morning at the fascinating task of painting as many different-appearing squares as you could, you would have at the end a bewildering mass of "light" and "dark," "rich" and "thin," "warm" and "cold" colors. Let us assume that the task has been done and set about the arranging of them in psychological order. Select a good strong yellow which is neither inclined toward the olives nor toward the oranges. Similarly select a good strong red which is neither orangish nor purplish. If now you were to lay out these canvas squares on a gray background you would find that you could select, in the course of an hour, a number of other squares from your morning's painting which would fall naturally between your yellow at one end and your red at the other, thus giving you the same kind of one-dimensional series as you produced in the grays. The colors would run as follows:

$$Y \text{———————} R$$

A great many reddish, yellowish and orangish squares you would have rejected simply because they would not easily fit into your series. Some were lightish and washed out, some were darkish and inclined toward gray or black. What you have selected and arranged you may regard as a series of *color-tones* or of *hues*.

---

general states and tunings of the eye, must be included in the gray series.

Suppose now that you select your richest and strongest green which is neither olive nor bluish and your richest and strongest central blue. You can make up a one-dimensional or lineal series, as before, by filling in between the terminal green and the terminal blue. These intermediates will include a number of the bluish greens and of the greenish blues.

Now place the two series near each other and observe them.

Y——————*R*

G——————*B*

Two facts will at once appear. (1) The upper colors (*Y* to *R*) all belong together and all the lower colors (*G* to *B*) belong together; but the two series taken as wholes are dissimilar. Our common speech calls the upper series the "warm" colors and the lower the "cold." (2) In spite of this difference in the two "branches" of the color family, however, it is possible to bridge the gap by putting in a number of olive canvas squares at one end (*Y* to *G*) and a number of purple squares at the other (*R* to *B*). Now you have a four-sided figure within which all the hues or color tones find their place. The figure must have straight sides and angles because the four colors at the corners are real *turning points.* When you set out from the *Y*-corner and move along the series to the right you find that you are exactly going toward red—not toward the blues or the greens. It would be incorrect, then, to make our figure a circle; for that arrangement would imply that there were no turning points, that the blues were actually anticipated when you set out from the yellow corner toward the reds. They are not. There is nothing in the oranges to suggest an approach to the blues; the suggestion comes only after the "red" corner has been turned.

A good many of the colored canvas squares are still to be disposed of. You decided that they did not fit "naturally" (*i.e.*, as qualities) into the figure of the hues or color-tones. How are they to be disposed of? Place your color figure at one end of the table, the light or "gray" series vertically at the other end, and the left-overs between. As you compare now the left-overs with the two series already finished, you will again be struck by two inspective facts. (1) Certain

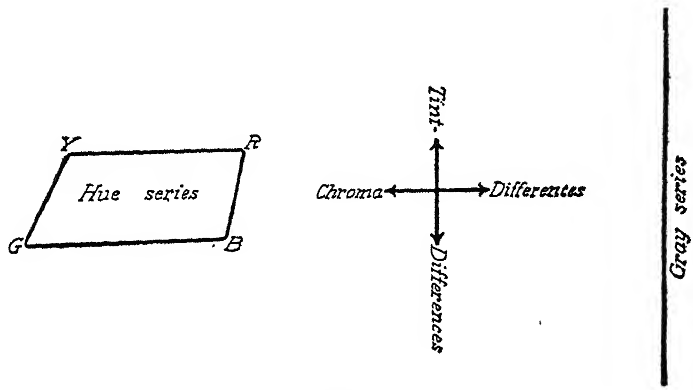


Fig. 2

of the left-overs obviously belong near the center of the table; *i.e.*, they have hue or color-tone, but they are also "grayish" or washed out. They resemble both the color figure and the middle region of the grays. They are color qualities of low "saturation" or low "chroma." (2) Certain other left-overs are similar to the white and the black ends of the right-hand line, although they do not quite belong in the line because they are "colors." They belong intermediately, too, but spread out toward the ends of the black-white series. They are of greater or lesser "brightness" or "tint" than the colors of the four-sided figure at the left.

By this time it will be obvious that all the relations now

inspectively established cannot well be represented on the table because the arrangement at the right is two-dimensional and does not show the proper relation of the hues to the intermediate group and to the grays. This relation is ordinarily represented by a geometrical figure in which the black-white series becomes the axis of the color-plane. This figure is known as the color pyramid (Fig. 3). It represents differences of color-tone or hue upon the lines running about the base, *B-G-Y-R; chroma* or *saturation* differences by horizontal lines, *e.g.*, c', c'', running out from the central axis, and the *tint* or *brightness* differences by vertical lines, *e.g.*, t', t'', drawn parallel to the *B-W* axis. The figure[2] then is solid and each spot within it or on its surface represents some one visual quality, either of light or of color. Taken as a whole it represents the entire system of these qualities. It is of the first importance to realize that the pyramid represents only inspective facts and relations of vision and that it makes no reference to pigments, to the properties of the physical spectrum, to the facts of light-mixture, or to the physiological processes in the eye and the brain. A second point of importance about the figure is that the hues, tints

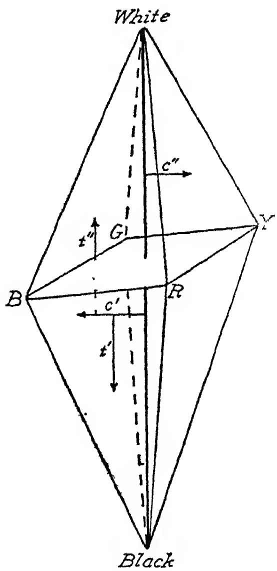


FIG. 3. COLOR PYRAMID

[2] Although the dimensions of the figure are determined by the relative number of qualities which the various lines represent, the whole scheme is geometrical. While, as we know, the four basal "hue" lines are of unlike lengths, no attempt is made in the figure to lay off the exact distances. The same may be said of other dimensions. The sole object of the construction is to give a clear notion of qualitative relationships within vision.

and chromas are not separate qualities. It would not be correct to regard one blue (say the "corner" blue of the figure) as a hue and a pale or grayish blue as a tint or chroma. Every color quality may be defined in terms of all three of these determinations. We say loosely that each of them "possesses" hue, tint and chroma, meaning that to place it precisely it is necessary to find its hue-place, its tint-place, and its chroma-place within the whole series. Each quality is then simple, but it has three-dimensional relations. It is as if we were to define a place in a given room as lying three feet above the floor, four feet along a horizontal line from a window, and seven feet from the door. It is, so to say, defining in terms of length, breadth and depth. A thing is not made plural by virtue of its plural relations to other things. That would be like regarding a person as three because he sustained one relation to his parents, another to his children, and a third to his brethren. No; every color quality is a hue, a tint and a chroma. But the independent variation of these aspects or attributes makes it possible for us to put all our qualities into a single (tridimensional) system. Although we may represent this system by concrete models, painting the surfaces and edges with appropriate colors and grays, we must remember that the entire series can never be viewed at any single time and under any single set of conditions. Within its sum total of qualities are included all degrees of illumination, from the faintest to the most brilliant, and all degrees of light and dark adaptation falling within the range of the normal eye.[3]

---

[3] The pyramid represents what Katz has called the plain (Flächen) colors, similar to those which are seen in the field of the spectroscope. "Film color" (proposed by the Cornell Laboratory) or "color screen" would be a better term. These are simple, unlocalized, pre-dimensional and pre-perceptive qualities. D. Katz, *Die Erscheinungsweisen der Farben*, etc. (1911), p. 8; M. F. Martin, *American Journal of Psychology* (1922), Vol. XXXIII, pp. 451-480.

The Relation of Visual Quality to Stimulus and Receptor. When once we have ordered our qualities a host of relevant problems arise; problems which have inspired a great number of researches in the psychological laboratories. Most of them relate to the way in which the qualities depend upon receptor and stimulus, *i.e.,* upon the eye and the character of the light which throws the eye into function. We can give only a hint of the nature of these researches.

1. *Visual qualities and the physical properties of light.* The most direct way to demonstrate the dependence of color quality upon wave length is to observe the solar spectrum, in which sunlight is analyzed into a graded series. What we see is a colored band with reds at one end (the long-wave end) and violet blues at the other (the short-wave end). Although we commonly speak of this array as sevenfold (Sir Isaac Newton's primary colors, red, orange, yellow, green, blue, indigo, and violet), careful inspection of the series, bit by bit, informs us that several score of different hues are actually present—and present in the order of the hue series around the color pyramid. Thus a beautiful parallelism appears between experience and the composition of the light-stimulus. It is obvious that experience and the receptor organ have grown up together under the influence of light. Near-lying wave lengths[4] produce similar hues (*e.g.,* red and orange, verdigris and Nile green); and distant wave lengths produce dissimilar hues (*e.g.,* red and green, blue and yellow). This parallelism has its limitations, however, as we shall now see. (1) The physical series we may regard as a continuum stretching, for the average eye under moderate illumination, from about $\lambda = 400$ $\mu\mu$ to about $\lambda = 760$ $\mu\mu$.[5] We may then regard it as containing as many

[4] The physicist's symbol for wave length is the Greek letter *lambda* (λ).

[5] The limits of the "visible" spectrum vary with conditions of illumination and also with the state of the eye. The Greek letter μ stands for 1/1000 mm.; and $\mu\mu$ for 1/1000 μ or 1/1,000,000 mm.

differences of wave length as we care to deal with. But the difference λ–λ must reach a given magnitude before a hue difference appears. Very small differences of wave length are said to be "subliminal" for hue. The total number of hues discriminable under the most favorable conditions within the limits of the "visible" spectrum is certainly above one hundred. When we make the count we discover further that the value of λ–λ which is just liminal varies from place to place in the spectrum.[6] You can easily demonstrate to yourself that fact by studying an ordinary lithographic reproduction of the solar spectrum. There you will see that hue changes very slowly in the long monotonous stretches of red and very rapidly in the greenish yellows. (2) In such a study of the solar spectrum you will also discover that the purple hues are absent; all those hues which lie approximately between the color of a ripe cherry, on the "red" side, and the lilac blossom, on the "blue." These hues are just as real as the "spectral" hues and every bit as elementary and simple. Were we to supply them (*e.g.*, by way of pigments) a further important detail of parallelism would appear. You now have recovered the complete base of the color pyramid; four series represented by the closed figure of four lines and four angles. The "psychologist's spectrum" (as it is actually made up in demonstrational form in the writer's laboratory) would represent these four series in natural order with a like rate of hue change running all the way around. The fact that we "see" cerise, mauve, lilac, and the other "purples" proves that some form of stimulus besides simple wave length suffices to stimulate the eye. And if we were to throw upon a single spot in the retina (as by a pair of mirrors) a ray of "blue" light (*e.g.*, $\lambda = 470$) and a ray of "red" light (*e.g.*, $\lambda = 670$), we should actually

[6] "Limen" means "threshold." "Difference limen" (*DL*) is a statistical value representing small qualitative (and other) differences in experience. (*Cf.* Chap. xvii of this volume.)

produce one of the missing "purples." Light mixture, then, is a factor. It is also a factor in producing the "spectral" colors, as your recollections of the child's set of pigments will convince you. (3) The whole problem of "color mixture," of the dependence of gray and color quality upon the composition of the stimulus light, thus confronts us. Fortunately for our exposition, simple uniformities or "laws" have been worked out. There is one "law" for hue, another for chroma, and a third for tint. For the psychologist they are most appropriately expressed in terms of *component* qualities (qualities whose stimuli are to be "mixed" or compounded) and *resultant* qualities (the outcome of the "mixture"). The "laws" run as follows. In reading them it is of the greatest importance to realize that the *physical lights* are *mixed*, never the color and light qualities, the qualities of experience itself.

I. *Resultant hues* lie between the hues of the component colors and nearer the stronger component.

II. *Resultant tints* lie between the tints of the component colors or grays and nearer the stronger component.

III. *Resultant chromas* (*a*) range between zero (complementary colors) and the chromas of the components and (*b*) vary directly with the component chromas and inversely with the qualitative remoteness of the component hues.

For the application of these laws it is not necessary that the "component" colors should have been produced by "unmixed" or homogeneous lights. The laws may be demonstrated as well by colored papers and transparent glasses, which give exceedingly complex lights, as by filters or by monochromatic strips from the solar spectrum. We may therefore add to our three specific laws a fourth, of more general import. It runs as follows:

IV. The "mixing" value of a physical light which produces a given gray or color is (under constant illumination) independent of its composition.

2. *Central and peripheral vision.* Were you to cover one eye and to stare fixedly with the other at a spot upon the opposite wall while an assistant slowly carried a bit of brilliant red paper or cloth from the neighborhood of the fixated spot to the right or left until you could no longer view it, the red would undergo qualitative changes. If it were a slightly orange red it would first grow yellower and at a later time it would change to a gray. Nearly all colored lights give rise to these changes of quality. So we discover that the actual visual quality which appears from a given stimulus depends in part upon the area of the retina to which the light stimulus is applied. At the outer rim or zone of the retina all lights produce (except under certain unusual conditions) only grays. An intermediate region gives rise to certain color qualities but not to others. As this region is poor in red and green vision, it has been called the yellow-blue zone. Finally, light cast upon and around the fovea (the area of clearest vision at the center of the retina) gives rise to all the qualities found in the color pyramid. These inequalities are indicative of widely differing degrees of sensitivity in the various regions of the retina. The local differences also remain when stimulus is reduced to the lowest chroma. Suppose that a given average wave length (say $\lambda = 522\ \mu\mu$). has to have the energy .08 (measured in some conventional unit) in order to produce at the fovea a given hue that is just different from gray (*i.e.,* a green of minimal chroma). We should then find that the same ray cast upon a small retinal area of 40 degrees eccentricity, along one certain meridian, would have to be increased to an energy of .80 in order to produce the same minimal green chroma. The following table[7] provides a representative view of these

[7] The table is made up from observations reported by Ferree and Rand, "Chromatic Thresholds of Sensation from Center to Periphery of the Retina and Their Bearing on Color Theory," *Psychological Review* (1919), Vol. XXVI, pp. 16-41, 150-163.

differences of sensitivity to four wave lengths chosen from the solar spectrum; one from the "red" region ($\lambda = 670\ \mu\mu$), one from the "yellows" ($\lambda = 581\ \mu\mu$), one from the "greens" ($\lambda = 522\ \mu\mu$) and a fourth from the "blues" ($\lambda = 468\ \mu\mu$). The "degrees" at the left indicate the distance (in terms of arc) from the fovea (nasal meridian) at which the stimulus is applied. Thus 90 degrees would mean that the light was cast from the extreme right or left into the "corner" of the eye.

LOCAL SENSITIVITY OF THE RETINA UNDER SPECTRAL LIGHTS

Degrees (o=fovea)	$\lambda = 670\ \mu\mu$ (Red)	$\lambda = 581\ \mu\mu$ (Yellow)	$\lambda = 522\ \mu\mu$ (Green)	$\lambda = 468\ \mu\mu$ (Blue)
0	.31	.16	.08	.08
5	.31	.20	.08	.08
10	.36	.31	.10	.13
20	.62	.61	.13	.20
30	2.05	1.94	.50	.20
40	3.29	2.85	.80	.30
50	4.11	3.97	1.50	.50
60	6.58	4.07	(23.80)	1.21
70	16.44	4.69	(290.10)	1.41
80	21.37	6.52		66.09
90	221.94	176.04		237.77

It appears from the table that (1) the center of the retina is most sensitive to monochromatic stimulation, (2) for a considerable distance outward (50 degrees for green and 70 degrees for blue) less energy is required to produce green and blue than red and yellow hues, and (3) at a certain degree of eccentricity the peripheral sensitivity drops off abruptly in the order green, red, blue and yellow.

3. *Color blindness.* This poverty of color from the outermost zone of the eye reminds us that some persons (perhaps one or two in a hundred of our male population) are blind to certain colors no matter where the light falls. The commonest form is *red-green blindness,* so named because the

reds and greens are seen as grays and so confused. This defect is usually congenital and it does not then denote any diseased or pathological affection. The color pyramid of the red-green blind is what you would see on the exposed surface if you were to cut the pyramid across diagonally from the *Y* to the *B* corner. Yellow and blue would be present at all degrees of tint and of chroma; but *R* and *G* would be lacking as well as the qualities along the *R-Y* and the *G-B* lines. Occasionally, in *total color blindness,* all colors are wanting. The pyramid is, therefore, reduced to the bare black-white axis.

4. *Dependence of visual quality upon spatial pattern and sequence of stimulus.* Every one knows the blue-gray shadows cast against snow under the yellowish light of a late afternoon in winter. This phenomenon, when translated into terms of retinal stimulation, reads: a bit of "gray" (white-light) stimulus set close beside a "yellow" stimulus gives the appearance of blue. This is known as *simultaneous contrast,* and it rests upon the fact that any local excitation in the retina, being chemical in its nature, spreads throughout the entire retina and is of maximal potency immediately next the stimulated area. The organic effect of the local stimulus thus extends as disease germs in a glass culture-medium spread and as the disturbance of a pebble thrown into water radiates in all directions.[8] In the second place, the stimulus also affects a *direct* change in the function of the receptors. Excitation gradually declines under the action of the stimulus. This change is called *adaptation.* On the side of visual quality it means a reduction of chroma toward the axis of the pyramid and a shift of white and of black toward middle gray. It is clear, therefore, that adaptation, if it were to proceed from all directions at once, would shrink the pyramid to a single small area near the center of the

---

[8] The terms of this spread and the processes induced in the eye we leave until we come to consider bodily conditions (pp. 94-5 below).

gray axis. That this reduction does not actually take place is due to a second temporal effect of the stimulus. Not only does adaptation mean a dulling of a particular region in the color system; it means also an opposite effect in another "complementary" region. Adaptation to "green" lights increases the sensitivity to red; adaptation to yellow increases the blues, and so on for every hue region. After exposure to green, then, a neutral gray tends to appear red; after exposure to yellow the same gray surface appears bluish. If the light stimulus is local, its removal leads to the *after image;* if it is general, the whole visual field is *tuned* toward the complementary color. Thus we are "tuned" by the predominant green lights of the summer foliage and "tuned" again by the high white light reflected by the snows of winter. In the first case we are said to be permanently "red-sighted" in summer and "dark-sighted" in winter. Thus the eye is nearly always biased toward certain regions in the color pyramid and away from others. It appears that this organic bias "mixes" with the outside lights, which are constantly impinging upon the eye; and the "mixture" appears to follow just the same "laws" as we observed for spectral and other lights. The effect of time, then, is to produce reciprocal or compensating effects; as if one were to drop one end of a balanced board downward and thereby to bring the other end upward. Stimulus dulls vision (chroma-wise) on one side and sharpens it on the other. This principle of compensation will occupy us again when we come to examine the visual receptor organs.

The direct effect of contrast is to sharpen boundaries, black next to white appearing blacker under contrast, and white whiter, red appearing redder (*i.e.,* more "saturated," of higher chroma) near green, and so on.[9] The direct effect

[9] Not only are "complementary" colors thus mutually enhanced, as we are accustomed to suppose. Every visual quality is modified in the presence of every other.

of adaptation, on the other side, is, since it brings a reduction of chroma, to soften and to obscure differences. Thus contrast "frames" objects by increased definition, where adaptation blurs. Nevertheless, the two phenomena are closely related through the principle of *opposition* or *antagonism*. In contrast, the antagonism appears immediately round about the stimulated area; in adaptation it appears by way of "mixture," and also subsequently, when relief from a stimulus allows the antagonistic or "negatively-colored" after image to appear. Again we must remember that the antagonism is physiological. The sensational qualities of experience are never themselves antagonistic.

5. *Twilight vision.* When the light stimulus is greatly reduced in energy a notable change appears in our visual system. Vision in weak light (as with oncoming darkness) is known as "twilight vision." We may compare it with "daylight vision" in terms of the pyramid. Our table given on page 63 shows us that very weak light gives rise to light qualities (the grays) but not to color qualities, and that the exact point where the chroma disappears depends both upon wave length and upon the retinal area affected. It is obvious that in very deep twilight the landscape will be colorless. As in total color blindness, the pyramid is therefore reduced to the black-white axis. But this loss of color qualities is not abrupt. As we all know, at the decline of day, woods and fields not only grow dark; they grow also somber; the colors are washed; the chromas are reduced. At this intermediate point a curious thing happens. The red hues lose in chroma and in tint much more rapidly than the blues. You can verify this fact by choosing a red and a blue pencil, candle or sealing stick, of about the same tint and richness in color, and carrying them into an almost lightless room. Under dark adaptation the blue grows *relatively* lighter and richer, the red going off into a very dull reddish black. That the entire series of hues suffers under this

change is shown by observing the whole solar spectrum in dark-adapted half-twilight vision. The red end grows a dull reddish black; the maximal tint shifts from yellow toward green, and the blues glow with relatively high tint and great chroma. This half-twilight shift is known (after the Austrian physiologist who described it) as the *Purkinje phenomenon,* and the shifted spectrum as the *Purkinje spectrum.* Described in terms of the pyramid, this half-twilight vision means a deep paring off of the outside of the figure, bringing all the sides and corners near the axis (absolutely low chromas), a cutting off of the white top (absolutely low tints), a lowering of the red corner, a crumpling down of the *Y*-corner, and a relative elevation of the *Y-G, G* and *B* areas (relative shift in tint). The blue corner stands out a little further than the red (relative shift in chroma). Since the equator has been greatly decreased in girth (all the high chromas having disappeared), the total number of hue differences is of course enormously reduced.

Taking together these five topics, which relate the visual qualities to stimulus and to receptor, two or three significant generalizations appear. (1) When we speak of "a system of visual qualities" we refer to the sum total of qualities derived under many conditions. We must remember that this totality is variously reduced and modified by (a) the wave length and the energy of the light, (b) the retinal region stimulated, (c) the state of "normal" color blindness, partial and acquired, and (d) the spatial and temporal relations of stimuli. Here we have only touched upon the most outstanding of the relations and the dependencies of vision. The facts, from which an exceedingly large and involved experimental literature has grown, have had to take into account the wide variability of stimulus, the great complexity of the ocular receptors, the close functional relation to the brain (of which the retina is a direct outgrowth), and, finally, the vast number of visual qualities themselves, each of them

ultimate and simple and all set into a compact and articulate system. These general statements will presently engage us again when we turn to the bodily conditions underlying the facts of experience.

B. *Auditory Qualities*

In their common descriptions of the raw materials of hearing, men roughly distinguish tones, noises, and vocal sounds. These classes correspond in a general way to the three great sources from which our auditory perceptions spring. Thus we speak of the "tones" of musical instruments, the "noises" of nature and of the street, and the "sounds" of the human voice. Since our concern is with auditory experience on its qualitative side only and not with the gross *sources* of that experience, we can scarcely set out by uncritically adopting such a classification, useful though it is in our common speech. We shall find, nevertheless, that "tone," "noise," and "vocal sound" play their part also in psychology.

The best way to get rid of all outside associations and prepossessions is to sit with eyes closed while an assistant at the back of the observer quietly and repeatedly taps with a light rubber hammer upon a tuning fork. The tuning fork is simply a rigid and elastic pendulum wagging wrong-side up. Its regular "pendular" movements give rise (when carefully operated) to a simple and prolonged auditory quality. The problem of the observer is to "live through" the experience and to discover by direct inspection what the quality actually is. In the psychological laboratories not only one but thousands of such qualities have been observed and compared. Our description will follow these observations. First, it appears that all these *tonal qualities* belong to one continuous system. In this respect they are like the members of the gray series which extend from the first black to the last white. The most obvious aspect of the tonal quali-

ties is *pitch.* The tones in the series continuously rise, as we say, from "low" to "high." In the entire series more than 10,000 separate qualities can be distinguished. But "highness" and "lowness" do not exhaustively describe these tones. The low tones are also "massive," "diffuse," "voluminous," and the high tones are "contracted," "small," and "sharp." It has been found that this difference in diffuseness or volume rests upon an inherent qualitative moment

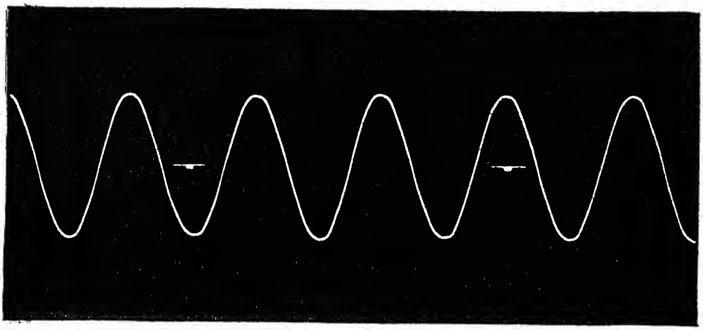


FIG. 4. ENLARGED REPRESENTATION OF THE MOVEMENT OF A TUNING FORK WHEN PRODUCING A SIMPLE TONE

This curve is made when one end of the vibrating tuning fork is allowed to rest on a sheet of blackened paper moving at a steady rate. From D. C. Miller, *The Science of Musical Sounds* (Macmillan Co., 1916).

in the tone. It is not volume in a spatial sense, the "big," low organ tone being so many cubic yards and the "little," shrill sound of the shepherd's pipe a cubic inch or so in size. While not in itself spatial, it is a "dimension" in experience which might conceivably have been used in the spatial orientation of the organism had not vision and touch served better. That "volume" is an aspect of the quality different from pitch is attested by the fact that several pitches may be alike in volume, the difference limen (*DL*) for volume being grosser than the *DL* for pitch; and also by the apparent dependence of the volume-*DL* upon *relative* differences of rate of the sounding source, whereas pitch is

dependent upon the *absolute* change of stimulus rate. Thus five observers[10] gave the following (average) *DL* values where tones were compared for pitch and for volume at the vibrational rates 275 and 550 in the one second:

	Tone 275	Tone 550
Limen for pitch......	0.92 vibrations	0.94 vibrations
Limen for volume.....	5.40 vibrations	11.40 vibrations

But the qualitative character of the simplest tonal experience is not yet exhausted. Tones are also "dull" and "bright"; the low tones being dull and the high tones bright. The course of brightness throughout the tonal series has not been adequately studied; but preliminary explorations suggest that brightness-change may go on, from below upward, precisely with pitch-change, the *DL's* being the same for both. But that the two moments are not themselves the same has been shown by recent experiments[11] in which a tonal stimulus was brought to the observer's ear through a circular row of holes cut in a revolving disk. Thus the wave-train was alternately transmitted and cut off, deforming the wave. By changing the relative size of the hole and intervening disk-space the experimenter produced differences of brightness without modifying pitch. A complete account of the tonal quality, then, includes its pitch, volume and brightness aspects. These moments suggest color-quality with its hue, tint and chroma. But there is a difference. An appropriate section of the color pyramid shows hundreds of qualities possessed of one hue at all chromas and all tints.[12]

[10] G. J. Rich, "A Study of Tonal Attributes," *American Journal of Psychology* (1919), Vol. XXX, pp. 121-164. The experimenter used pure tones produced by blown bottles (Stern's) and interference tubes.

[11] O. Abraham, "Zur physiologischen Akustik von Wellenlänge und Schwingungszahl," *Zeitschrift für Sinnesphysiologie* (1920), Vol. LI, pp. 121-152.

[12] *E.g.,* A vertical section through the *R*-corner to the axis. One *R*-hue alone is exposed.

A given pitch, on the other hand, does not, so far as we know, thus display a series of brightnesses and a series of volumes. For this reason it is difficult to represent in any spatial figure the qualitative series of tones. The proposal [13] to use a "tonal pencil," sharp at one end and flaring at the other, the lengthwise dimension to represent pitch and the diminishing cross-dimension the decreasing volume, ignores this fundamental difference in the facts of visual and tonal experience. Since pitch dominates the quality, making up, so to say, the *salient* aspect of it, it will be simplest to regard the tonal series as a continuous series, the members of which are distinguished by the three moments, PITCH, volume, and brightness.

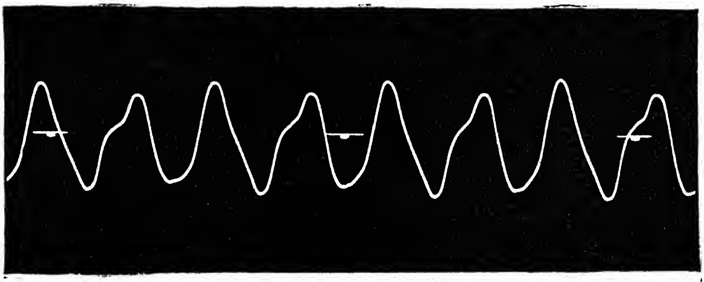
This qualitative description seems to offer a basis for musical sounds; but what shall we say of speech or of noise? As every one knows, speech is complex, just as music is. We must, then, first reduce it to its phonetic constituents, which are roughly divisible into vowel sounds and consonant sounds. Now a vowel sound bears an obvious relation to tone, though it is complex where a tone is simple. When we run through the series *u* (moot), *o* (mote), *a* (art), *e* (ate), and *i* (bee), we soon discover a pitch progression, a diminution in volume and an increasing brightness. But when we try to identify each vowel with one particular tone (as in a tuning fork series) we fail to discover identity. No vowel is exactly the same as any single tonal pitch. It was first thought that this lack of correspondence was entirely due to the complexity of the vowel sound or "vocable." Helmholtz said that each vowel was composed of a series of harmonic partial-tones similar to the note, one or more of the partials being emphasized in utterance by resonance in the mouth. Hermann objected that the mouth cavity made its own fixed contribution (the "formant") which was not usually harmonic with the tonal components from the vocal

[13] E. B. Titchener, *A Textbook of Psychology* (1910), p. 94.

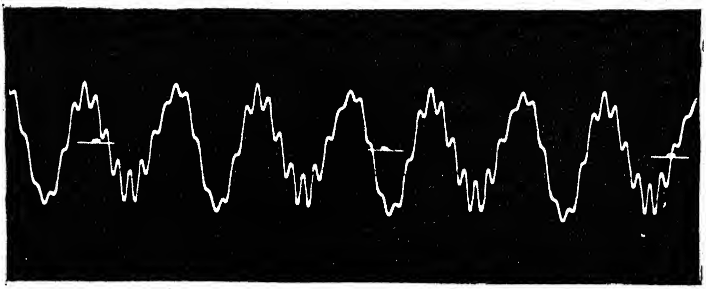
chords. Recent experiments under refined conditions make it appear that Helmholtz was probably right as regards the harmonic relation of the characteristic partials in the vocables and Hermann right in his insistence upon the unique character of this factor, the formant. Now what *is* the character which makes the vowel sound unique? In the first place, each formant appears to correspond to a *tonal region* and not to a single vibration rate. In its qualitative nature it is wanting in the salient "pitch" aspect. It is instead a dull, soft, "unpitched" accompaniment to the fundamental tone upon which the vowel sound is based. Here, then, the aspect of brightness, which may, as we have seen, vary independently of pitch, seems to usurp the place of pitch and to give a characteristic coloring to the sound. We might, then, indicate its qualitative formula as pitch, volume, BRIGHTNESS. Its function in the vocable is believed to depend in part upon the clearness of the fundamental and the obscurity of the formant, because attention directed to the formant itself destroys the vowel character or vocality of the sound. On the side of stimulus the degradation of pitch and the shift in brightness are believed to be dependent upon a long crest and a low trough of the sound wave. The effect of this form of the wave upon the receptor we must keep in view when we come to discuss the bodily conditions of auditory qualities.

As for the noises, it is not difficult to discover evidences of the close qualitative affiliation of these sounds with tones. A small stick dropped upon the floor gives a characteristic sharp, clean noise; but if we cut a dozen sticks to appropriate dimensions and drop them in order something very like a tonal sequence emerges. In fact, one musical instrument, the xylophone, produces sounds of just this "noisy" character and still may be "tuned" to the musical scale. Again, very high and very low tones are distinctly "noisy," and even within the middle range the drum and the cymbals

"thump" and "clash", while ten adjacent keys struck together upon the piano produce a sound more thunderously noisy than musical. But all of these sounds are obviously complex, and if we are to compare them with tones we must, of course, reduce them, as we did the vowels, to their lowest terms. Toward this end, the psychologist has received but



The vowel *oo* as in "room"



The vowel *ee* as in "bee"

FIG. 5.

From R. M. Ogden, *Hearing*, (Harcourt, Brace & Co., 1924).

little aid from the physical acoustician, who is generally content to describe a noise either as an imperfect tone or as an aperiodic vibrational movement. So far as the experimental evidence goes, however, the simple noise appears

as an auditory quality whose pitch component is more like the formant than like tone and whose "brightness" is characteristically rough and dull. The formant would seem to stand as an intermediate between tone-quality, on the one side, and noise-quality, on the other. It is almost certain, however, that most of our noises are rough, dull complexes whose total qualitative character is determined by varying degrees of pitch saliency, volume and brightness. If we leave these complex qualities out of account until we come to the integrative side of experience, we may summarize our discussion by saying that all the simple auditory qualities possess the attributes of pitch, volume and brightness. In *tone* pitch is clear cut, obtrusive and dominant, and its changes coincide with the changes of brightness. In the *formant* (the characteristic part of the simpler vocal sounds) pitch is no longer the salient attribute. It is dominated by brightness which moves in partial independence of it. In the vowel sound the formant contributes a shading or vocalic character to the fundamental and other tones. In the simple *noise,* finally, pitch is still more obscure than in the formant. It resembles a whole region of tonal pitches without coinciding with any single one. Thus we know that distant thunder is lower in pitch than the crack of the rifle and this in turn lower than the pop of a soap bubble or the hiss of escaping steam; but no one of these noises coincides with a single pitch-position in the tonal scale. More characteristic of the noise is the variable brightness and possibly also an added attribute of roughness.[14]

Beats. When two tones whose vibrational rates are almost coincident—say 300 and 303 vibrations—sound together, a

[14] It should be borne in mind that these observations are extremely difficult and that upon certain points psychologists have not as yet reached perfect agreement. *Cf.* R. M. Ogden, *Hearing* (1924), pp. 48-119; D. C. Miller, *The Science of Musical Sounds* (1916), pp. 215-243.

strange slow throbbing is heard. When inspected this throbbing is found to consist of a regular alternation of intensity, weak, strong, weak, strong, etc., of a single tone. When the two rates are separately sounded, one after the other, they are observed to be of different quality; but the selfsame stimuli given together to the ear arouses only one quality and that quality at a variable intensity. The energy-movements in the stimulus are represented in Figure 6. The light lines represent the two rates and the heavy line the algebraical summation of them. The flat place at the center is due to

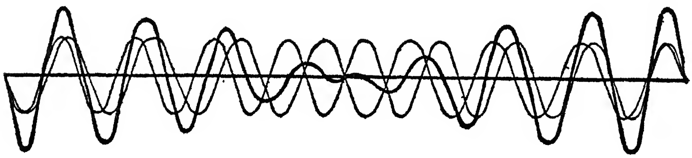


FIG. 6. WAVE-TRAINS UNDERLYING BEATS
From R. M. Ogden, *Hearing*, (Harcourt, Brace & Co., 1924).

opposition in phase of the two wave-trains. It is at this point that the tone becomes weak. With a greater difference in vibrational rate (and therefore with a greater qualitative disparity of the tones) the two primary qualities reappear; and, in addition, a third, rough, noisy, beating tone intermediately placed comes in. At a still greater separation, the middle tone disappears leaving only the two primaries, but these now rough and noisy. The latter phases are of especial interest to the psychologist, first because they afford an instance of noise with two simple and periodic "tonal" rates, and secondly because the noise quality slips in as by stealth when the intensive alternations gradually increase.

Difference Tones. As the beats disappear, owing to the spread of the rates of physical vibration, a new phenomenon appears. It is the difference tone, which corresponds (in

its simplest case) to the difference in the two rates. Thus when the tones $C_6=2048$ and $D_6=2304$ sound together, there is added the tone $C_3=256$ ($2304-2048=256$). In most cases the physicist is unable to discover such a component in his compound wave-train; so it is probably necessary to refer it to the functions of the ear; a fact which we must keep in mind for our discussion of the bodily conditions of hearing. These difference tones are ordinary tonal qualities bearing no mark of their strange bodily origin. But they play an important part in speech, song and instrumental music.

C. *Taste and Smell Qualities*

The close alliance which we all recognize in taste and smell, in the "chemical senses" as they are called, is practical rather than psychological. The receptor organs for both stand guard together at the gateway to the digestive tract. As they are alike thrown into function by edible substances taken into the mouth, it is natural that they should make joint contributions to the flavor and the savor of food. We commonly speak of "taste" where the psychologist distinguishes gustatory qualities (taste proper) and, in addition, olfactory qualities (smell proper), as well as cold, warmth, pressure, burn, and other "non-chemical" ingredients. Smell has the advantage of a "distance" receptor, for it is also excited by diffused chemical substances borne in minute quantities through the air to the nose; and when the olfactory qualities are thus brought into experience without direct contact of the odorous mass with the body we have no difficulty in recognizing the odors as characteristic and independent perceptions. On the other side, we have only to confine the stimulus to the tongue, by stopping the nasal air passages, and then to eliminate pressure, temperature and the other extraneous qualities, to realize that the tastes also are unique and not to be confused with smell or with any other sense. In arriving by inspective means at the taste qualities the

psychologist had first, of course, to cast aside all perceptive names, such as the taste of wine, of sweetmeats, of flesh and of vegetables, and accept only such underived and unmixed qualities as actually appear with the excitation of the taste receptors, without regard to the chemical or the dietetic nature of the stimulating substance. The qualities so derived have been gradually reduced to four—bitter, sweet, sour (or acid) and salt. Upon these four experimental research is generally agreed. There is agreement, too, upon the fact that taste mixtures or "blends" also occur. Thus sweet and sour both contribute to the taste of lemonade and bitter, sour and sweet to the flavor of the ripe peach.[15] But the existence of simple intermediates between our four qualities is another question. Is there, for example, a single new gustatory quality that stands related, on the one hand, to sweet and, on the other, to salt? Kiesow, an indefatigable student of taste, has maintained that there is and that it is to be described as the "vapid," "insipid," or "flat" quality. The simplicity of this taste has been questioned; but other intermediates have lately been alleged, intermediates which stand to two of our four "corner" tastes much as the orange hues stand to red and yellow and the purples to red and blue. Thus Henning puts baking soda and ammonium chloride between salt and sour, sugar of lead between sweet and sour, acetone between sweet and bitter, bromide and iodide of postassium between salt and bitter, "alkaline" between sweet and salt, and sulphate of potassium between sour and bitter. Whether a complete set of these gradations exists, to be represented by straight lines connecting salt and sweet, bitter and sour, etc., we do not know; but the facts at hand are

[15] An interesting and popular summary of the facts of taste, brought down to about 1915, will be found in *The Sense of Taste* (H. L. Hollingworth and A. T. Poffenberger, 1917). The absence of references and of a systematic review of the literature makes the volume virtually useless in scholarly work.

best represented for the time being by the taste tetrahedron, proposed by Henning,[16] and represented in Figure 7.

If the graded series are complete, then we should have all the simple qualities represented along the six edges of the figure with salty at the apex and sweet, sour, and bitter at the three corners of the base.

In comparing the taste tetrahedron with the color pyramid, we must note in the former (1) nothing like a "neutral" axis to which all color qualities stand definitely related, (2) no reference at all to the interior, all the taste qualities being confined to the surface of the figure, and (3) no independent variation—so far as we know—of such general qualitative moments as hue, tint, and chroma.

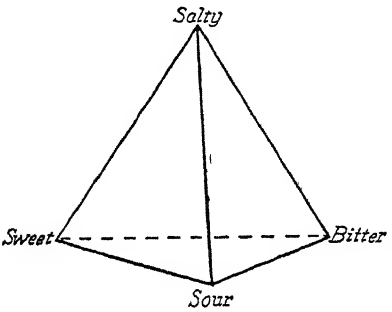


FIG. 7

The comparison with vision leads us to ask whether tastes likewise display compensation or "antagonism," two "opposite" tastes destroying one another; and whether, again, one taste may enhance another by contrast. Evidence of both appears in daily life. We mask the bitterness of coffee with sugar (compensation), and we pucker at the enhanced sourness of grapefruit taken after sweets (contrast). Of course, these are not pure gustatory cases, for many other qualities enter; but experiment has confirmed them to some extent. In the case of compensation, no *complete* mutual antagonism (entire loss of both qualities) has been substantiated, though the reduction of one quality by another is a general phenomenon. Contrast seems to occur between each pair of the four

[16] H. Henning, *Zeitschrift für Psychologie* (1916), Vol. LXXIV, p. 212.

"corner" tastes, though contrasts with bitter have been questioned. Although these interdependencies of quality upon quality are obvious, we should be cautious in carrying over from vision the concepts of "antagonism" and "contrast" for, as it has been suggested (Parker), we may in the case of taste be really dealing with sensitizing and desensitizing processes by means of chemical agents.

The stimulation of the taste receptors (called "taste buds") is plainly of a chemical nature. Our knowledge of the chemical difference underlying even the four "corner" tastes is far from complete; but we may say with some assurance that the *sour* quality is (at least generally) due to hydrogen ions; *salt* to the ions (anions) of chlorine, bromine, iodine, and some other substances; *bitter* to ions (cations) and, especially in morphine, quinine, strychnine and other alkaloids, to certain atomic groups of which the nitro group NO_2 seems to be best recognized; and *sweet* to certain atomic groups, notable in some of the alcohols and sugars, whose character and activity are not fully known.[17]

When we turn to *smell* we find our task enormously increased. It is only within the last decade that we have had classification and description of the qualities at all comparable with the other senses. These qualities are unnumbered, if not innumerable. The fact that most of our names for odors are borrowed from objects and chemicals (*e.g.*, rose, violet, heliotrope, camphor, onion, rubber, vanillin, chlorine, ether, etc.), suggests the difficulty of divorcing them from their multitudinous sources and of reducing them to order. Linnæus distinguished nine gross classes which the Dutch physiologist Zwaardemaker has introduced in modified form to the psychological literature of smell. Although Zwaardemaker has greatly advanced our knowledge of olfaction, his classes are but a first approximation to an orderly account.

[17] G. H. Parker, *Smell, Taste and Allied Senses in the Vertebrates* (1922), pp. 134-145.

In 1916 Hans Henning[18] proposed a thorough revision of this classification by making a direct comparison of hundreds of smells chosen from a large number of sources. As a result of his investigation he proposes six "corner" odors which occupy a position in the whole qualitative system somewhat analogous to our R, Y, G and B corners in the visual system and to the four corners of the taste tetrahedron. Henning's olfactory prism is represented in Figure 8. The six "corner" smells are fragrant, spicy, ethereal (fruity), resinous, putrid (foul), and burnt. These six names do not stand, however, for six qualities alone. They indicate, instead, six classes which are interconnected along the lines of the prism. Thus between the two left-hand corners stand the fragment-spicy odors, as simple as the "corner" qualities but having a double aspect (as the orange colors have), a likeness to fragment and a likeness to spicy. This relation holds, at least theoretically, for all nine edges of the figure, and upon the faces we have other simple qualities sustaining more complex relations with the corners. As Henning believes, then, all the simple odorous qualities belong to a single articulated system whose members and relations may be represented upon the surface of the prismatic figure. The space within (departing again from the order of the visual pyramid) is reserved for an indefinite number of mixtures or smell-complexes. Each simple quality is

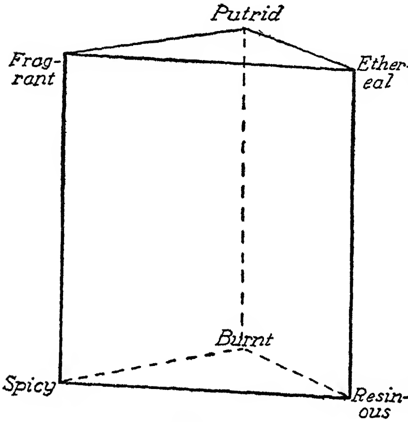


FIG. 8

[18] H. Henning, *Der Geruch* (1916), (2nd ed., 1924).

produced, as Henning contends, by a given chemical substance and cannot be exactly reproduced by a mixture of any other substances.

Many attempts have been made to solve the chemical riddle of smell; to determine the constitution of odorous substances. The facts are obviously complicated. Nothing corresponding to wave length and light composition has been made out. Henning's own attempt, which rests upon the mode of connection of certain atomic groups and radicals within the benzene ring, is directed toward the explanation of his own six qualitative classes.[19] The scheme is certainly not usable without modification. It is possible that it may be made more intelligible when the qualitative system of six classes, which is by no means final, has been sufficiently revised. Parker's inclination[20] to work out the chemistry of olfactory stimulation on the principle of separate components and to persuade the qualitative classification to conform to the results is no more to be commended here than in taste, audition and vision. To know conditions without a descriptive knowledge of the experimental facts conditioned is to make a logically wrong beginning. Henning's six-fold classification is the first concrete and thorough-going attempt to isolate the olfactory phenomena from everything else, and to establish by direct comparison exact qualitative likenesses and differences. His results are far too few and many of them too uncertain to establish a definitive system; but they furnish a basis upon which to work. Already have they suggested more rigorous methods of experimentation.[21] Henning has insisted on a rejection of all nonodorous quali-

[19] It is obvious that Henning's theory relates most naturally to the aromatic odors, which lie on or near the front surface (*FESR*) of the prism.

[20] G. H. Parker, *loc. cit.*, p. 76.

[21] *Cf.* F. L. Dimmick, *American Journal of Psychology* (1922), Vol. XXXIII, pp. 423-425; M. K. MacDonald, *ibid.*, Vol. XXXIII, pp. 535-553.

ties; and it seems likely that this refinement in method and in observation must be carried still further before our classification can be made complete and final. Inhalation itself, when pronounced, sets up a "dry" pressure in the nose, and, again, many substances are irritant (attacking the trigeminus nerve) as well as olfactive. Moreover, "attention to smell" is likely, except under the most rigorous training, to mean "attention to the nose" or "attention to inhalation." In making olfactory comparisons on the basis of quality alone, the present writer has found that smell itself is frequently—and possibly always—non-localized. Nowhere in inspection, so far as he knows, does the observer report, under the "process attitude," qualities so utterly divorced from spatial and other "objective" adhesions as in smell.

D. *Somæsthetic Qualities*

Tradition accords to man five senses, sight, hearing, taste, smell and touch. According to this inventory touch alone remains for our description. But here the tradition cannot be sustained. Instead of a "fifth" sense we discover upon inspection a fairly long list of sensational qualities deriving from many receptors and displaying closer or more remote family resemblances. A group of these qualities, showing moderately close relations, includes pressure, warmth, cold, heat and pain. All the members may be experienced by appropriate stimulation of certain localities in the skin, the linings of the mouth and pharynx, and of the inner surface of the œsophagus. The stomach (or adjacent tissues) gives rise, under "artificial" stimulation, to pressure, cold, warmth and pain, the colon to pain and pressure, and the lower end of the digestive tract to these qualities as well as to cold and warmth.[22] Contraction of, or

---

[22] E. G. Boring, *American Journal of Psychology* (1915), Vol. XXVI, pp. 1-57, 485-494; A. J. Carlson, *The Control of Hunger in Health and Disease* (1916), pp. 101-118.

pressure upon, the muscular tissues produces a characteristic dull (muscular) pressure which may become pain by intensive stimulation and which changes, under long-repeated contraction, to an achy and dragging "fatigue" quality regarded by some psychologists as unique and elementary.

It need scarcely be said that this fatigue quality is not to be confused either with a toxic condition of muscular tissue (the physiologist's "fatigue") or with the general complex state of the organism which we perceptively apprehend as tiredness, exhaustion, lassitude and so on. Tickle, which has been regarded as one of the "cutaneous sensations," appears to be fairly complex and to involve no new qualitative component.[23] Receptor organs upon bony surfaces surrounding the joints appear also to be responsible for a pressure ("articular pressure") which is indistinguishable from the cutaneous quality.

As to pressure, different qualitative shadings are observable. One is known as "contact," an instable diffuse quality, which sometimes arises under light stimulation; another is the firm, condensed and "solid" pressure such as appears when a dull wooden point is brought firmly against the skin. Cold appears to include only one shading, though a slightly different "cool" has been proposed. Heat and warmth are unlike qualities, warmth being more like pressure than like cold. Heat is allied to cold and also to pain. Produced by the simultaneous excitation of near-lying cold and warm spots upon the skin, it is nevertheless a single quality.[24] For pain

---

[23] E. Murray, *American Journal of Psychology* (1908), Vol XIX, pp. 289-344.

[24] The production of heat by immersion in hot water or other liquid is explained by the curious fact that the "cold" organs are set into function by moderately high temperatures, *i.e.*, 45° centigrade and above. Cold thus produced is called "paradoxical" cold. In quality it is precisely the same as the cold set up by temperatures lying below the "indifferent" or neutral point of the skin, about 33° centigrade.

we have many epithets such as "stabbing," "cutting," "stinging," "aching," and "tearing"; but most of these epithets are perceptive, relating to the damage wrought upon the organism by the "painful" instrument or object. Apart from intensive differences there are, as it appears, very few qualitative shadings of the pain quality. The description of these shadings is still unsatisfactory.

These experiential resources of the organism appear suspiciously meager and inadequate for the functions which they serve to carry. Inadequate on the side of knowledge, for the "cutaneous senses" supply, in large measure, our varied and abundant information upon the superficial properties of material objects, upon their size, shape, movement, roughness, smoothness, bluntness, softness, hardness, oiliness, slipperiness, wetness, stickiness, and so on. Inadequate on the side of bodily state and change, for we appear to depend primarily upon sensations from the thoracic and abdominal viscera for the states of health, energized alertness, nausea, seediness, and the like; for the bodily deficiencies of hunger, thirst, sexual analepsis and general exhaustion; for the wide variety of mood; for the "organic core" of the perceived self; and, finally, for the bodily reference in emotive seizures. Many offices; few qualities! Let us inquire into this apparent paradox. As for the superficial properties, we now know, thanks to the "synthetic" experiment,[25] that part of these perceptive functions are carried by the fusion of two or more of our qualities (*e.g.*, liquidity by temperature and pressure), and some of them by intensive, extensive and durative patterns of a single quality (*e.g.*, surface-roughness by pressure). As for the general "energy" states, we must add both the factors of tendinous strain, still to be described, and many associative components. In the self-referring perceptions, the emotive "stirs" and the "deficient" states, we

[25] *Cf.* M. Bentley, *American Journal of Psychology* (1900), Vol. XI, pp. 405 *ff.*; A. H. Sullivan, *ibid.* (1923), Vol. XXXIV, pp. 531 *ff.*

play the changes upon our simple qualities combined in many specific ways. As the chemist knows and the student of anatomy knows it is possible to produce an incredible variety by the varied combination of a few ingredients. Hunger and thirst having been analyzed with some finality, we know that they are made up of pressure, temperature and pain carefully integrated. As for "sensations" of hunger and thirst we now know that these do not exist.

With due allowance made for the high specificity and "individuality" of simple complexes, the psychologist must still admit that his description of the "internal" experiences is incomplete. In view of this incompleteness two remarks should be made. The first is to note the fact that most of our careful inspection of "visceral" qualities has been made under artificial insult to the inner organs, *e.g.*, the pressure balloon to the stomach and the electric current to the walls of the œsophagus. But these alimentary regions and organs are normally the seat of digestive, secretive, and peristaltic processes which may tinge and color experience in a way not realized by "outside" stimuli. In digestive disturbances we find, to be sure, our pressures, pains and temperature; but it looks as if these qualities might not be exhaustive. The second remark bears upon our conception of experience as directly indicative, as well as informative; as a gauge registering the events of metabolism and of vital shifts as well as a phenomenological storehouse of qualities which go to make up knowledge. It is this "vital" side of experience which is mainly responsible for the variations in mood and in emotive inclination, as well as for the thrust of desire and the urge of appetite. How the autonomic nervous system and the secretory organs which it commands may be especially concerned with this "vital" aspect we scarcely know.

Kinæsthetic strain. The strain quality is everywhere to be found in experience. Although it is closely associated, on the side of bodily conditions, with the contraction of muscle

and the deformation of the skin it appears to stand psychologically apart from the preceding qualities in this group; though it may be related to them through the brighter pressures and pains. Frequently set down with muscular and articular pressures as a member of a "kinæsthetic" constellation, it would seem to be as remotely related to these as to qualities derived from the skin and from the viscera. We may do well to treat it by itself. It clearly stands out as a bright clean-cut "pulling" quality in such complex experiences as the lifting of a moderate weight upon the outstretched hand or as the bending sidewise at the hips. The quality is sometimes called "tendinous strain" because its receptor is in the tissue of the tendon, and is set into commission by the functioning of this organ. Thus it is closely associated with movement; and it is doubtless this association which has given to the strain quality its high importance in the performances of the total or psychosomatic organism. Without this favoring circumstance it would be difficult to understand the high utility of the strain quality in the service of the body. In our functional sections we shall find it playing its part in the perception of objects, of time, and of the bodily self; in memory and imagination, as well as in action, and also in emotion and thinking. Its wide uses would seem to suggest high qualitative complexity; but when we inspectively regard the tendinous element by itself it evinces great constancy and uniformity whether it derives from the pull of the frowning muscles, the sag of the mouth, the clenching of the fists, the straightening of the back, or the rhythmical walking movements of the legs. The *meaning* of these bodily postures and changes is highly varied; but no one has found a like qualitative variety when the bright pulling tendinous component has been analyzed out and separately observed. Only the local reference to the place of origin within the body would seem to distinguish one strain from another. Perhaps the setting forth of the phenomenon as a peculiar

constituent of experience will lead to a more refined comparison of its shades and nuances.

II. The Sensimaginal Qualities

The wide difference in experience under the rule of stimulus and under the freedom of central factors has long been remarked. It variously appears in the distinctions of perception and thought, of sense and intellect, of impression and idea, of presentation and representation, of sensation and image, and of sensations centrally initiated as set over against similar processes thrust into being by the impact of the physical world upon the senses. With such distinctions themselves we have at present little to do. They interest us only as they suggest a twofold classification of the observed qualities of experience. That phenomena similar to colors, tones and pressures arise without the immediate intervention of the receptors, when we remember or imagine scenes, sounds, contacts and bodily performances, we all know. We commonly say that when we remember or when we imagine we "revive" or "rearrange" our former sensations. What we actually revive or rearrange is, of course, the old *context* of the old scenes, old songs, old occurrences, and the like. We never really restore the old qualities of experience themselves. But we do find that the memories and the imaginations rest in large measure upon sensimaginal qualities which are similar to the sensational models just now reviewed. These we must briefly describe.

Our first observation is that the sensimaginal furnishings are relatively meager in extent. Except under special conditions,[26] most men probably do not possess imaginal heat, cold, warmth and pain. Imaginal strains are difficult to substantiate. There is the initial trouble of making sure that the

[26] One condition appears to be the close fusion of sensimaginal qualities with sensational in the mixed incorporation (see below, Chap. v)

tendinous organs are really thrown out of commission; for any instruction which leads the observer to "imagine" or to "think about" such a strain quality as might come from a nod of the head or a lifting of the arm is likely to lead also to a slight actual innervation of the muscles and tendons appropriate to that movement. Training in relaxation and in report partially removes this source of error, which is further checked by cases of local paralysis where the peripheral organs are thrown permanently out of commission. A recent research,[27] which carried on parallel observations of "kinæsthetic sensations" and "kinæsthetic images" of self movement, concluded that the sensimaginal qualities are "all 'pressury' "—either "dull" pressure or "light" pressure. There was "neither strain nor ache in the image, though the . . . image may mean a movement that would be strainful or achy in sensation." The absence of strain is further attested by the description that the "image" quality is "dead and static" while the sensation "has brightness or liveness or sparkle, and is dynamic." When the observers emphatically regarded some other person as moving or as taking a bodily posture (*e.g.*, the "feel" of Laocoön struggling with the serpent), then, to be sure, they reported strain; but here the attitude was that of perceptive meaning with little true inspection and much commentary.[28] There is no guaranty that the "strain" meaning was not carried by a surrogate for "imaginal" strain; either a similar sensational quality (from actual motor innervation) or a visual makeshift. We still want competent testimony to the existence of the sensimaginal strain.[29]

---

[27] A. H. Sullivan, *American Journal of Psychology* (1921), Vol. XXXII, pp. 54-80.

[28] "The situation is objectified, and the *O* contemplates it as he would a landscape; the report upon the imagery is more like an *Aussage*-report than a scientific description" (*ibid.*, p. 71).

[29] In the author's attempt to invoke it while actually contracting the antagonistic motor group (*e.g.*, "imaging" a strain of an inward flexing swing of the forearm while actually extending the arm

It is sometimes assumed that the "motor-minded" (who derive perceptive and other meanings largely through movement) make free use of "kinæsthetic imagery"; but their tendency toward gesture, pantomime and posture leads us to doubt whether their strains are not actual sensations. Taste and smell sensimages have been reported, and it appears likely that they are not uncommon in some; though the individual differences are evidently great. Most of us recall and imagine gustatory and olfactory experiences in substitutive terms. Individual differences are found also in auditory and visual imageries. At one time they were supposed to indicate distinct memorial or ideational "types"; but that belief has been greatly modified. Now and then an individual is grossly defective in the one or the other; but more frequently the functional employment of this material depends upon the occasion, one and the same person sustaining (say) a memory for places by bodily pantomime, a memory for faces by visual means, and a memory for music by auditory "reproduction." That very small pitch differences and color differences can be realized in imaginal terms has been amply demonstrated. The various ways of ligating sensimaginal processes and of attaching them to the sensational qualities (as in the "mixed incorporation") will be explained in the subsequent treatment of mental integration.

III. The Affective Tone of Experience

Thus far all our constituents have been more or less alike. We could regard them as qualities fused, blended, ligated or integrated in the tissues of experience. Whether sensational or sensimaginal, they all displayed a family likeness, and they alike entered into the configurations and fluent patterns which make up the "mental" side of the organism.

---

outward) the flexion meaning was either carried by some surrogate (as vision) or it did not come at all. The method deserves further exploitation.

But the feelings are, as we have seen, of a different order. They are never "blocked in"; they never are localized or "placed" with respect to the qualities already described. They have been likened to the haze upon the mountains, the mist spread throughout the valleys and the varnish or sizing upon the painting. They "tone" but they do not "inhabit" experience. As regards their origin in life the simple feelings are taken to represent, in their opposite phases of pleasantness and unpleasantness, opposed metabolic swings of the entire organism, possibly a momentary excess in repair or depletion. This view of feeling is consonant with the belief that it represents, in the simplest experiential form, the ebb and flow, the rise and fall, of life; that it stands as a gauge or indicator of the most general and integral aspects of those somatic processes and shifting relations which, taken altogether, we know as life. While these two tones of feeling thus represent in the most general and fundamental way the tides of life, we must also recognize the indicatory aspects of experience upon other levels. In moods, too, in emotion, and in the shifting "organic" mass which forms the permanent ground of experience we come upon this surdal and non-sonant element. Analysis, then, taken in the ordinary sense) does not touch feeling, which is inarticulate and uncompounded; and as it is symptomatic of the fluent course of life we may surmise that it is the ancestral form of mind, the background, so to say, upon which experience, in developing, has written the particularities of the individual career.

IV. Quantitative Attributes

In analysis and description quality holds an unique position. We may, to be sure, partition and divide spatial wholes into halves, quarters, and other extended parts, break up the day or year into lesser durations, and resolve weights and energies into less intensive magnitudes. Here we have

a variety of subdivisions and fractionations which serve to furnish a sort of piecemeal description of material objects and agents. A great deal of physical science, on its quantitative side, is based upon this sort of description—as a review of its units and constants would show. But experience itself in its raw and fluent state is not to be chopped into aliquot parts, not to be temporally disarticulated, and not to be treated as a greater magnitude to be divided up into lesser. No! Quality and qualitative analysis here hold a distinctive place. Let us see how the case stands for the "quantitative" claimants to recognition.

Intensity. It is obvious that we can say of a tone, a taste or a tendinous strain that it is more or less, that it is stronger or weaker. Inspective description reaches thus far. Furthermore, we may compare like or unlike qualities on the intensive side and report them, or even a group of them, as like or different. But of unit and multiple magnitudes we do not here speak. We do not say, *e.g.,* that one low tone, bitter taste or fragrant odor is twice or thrice another; though we readily observe likeness and difference between them. Intensity is not thus divisible in experience.[30] As for an intensive series or "scale," it is obvious that the relations of more or less suggest a one-dimensional continuum; and we know from the Fechner-Weber Law that series of like intensive differences of this order stand related in a fixed way to stimulus increments throughout the middle range of many sensational qualities.[31] For absolutely small and great intensities the fixed "psychophysical" relation has not generally been found. A curious complication of intensity with quality occurs in vision. We speak of the il-

---

[30] Whether a fixed *difference* of intensity (*e.g.*, a liminal difference) may be regarded as a unit we shall consider in connection with "measurement" (Chap. xvii).

[31] For the significance of the "law," see below, pp. 405*ff*., and references there cited.

lumination of a room or of the sky as being "strong" or "weak," of light as being "brilliant" or "dull"; but, when we rule out perceptive factors and make a simple comparison of two lights or colors, the obvious difference which we observe is a difference of quality. One brightness is a white or light gray, another a dark gray or black. We know, moreover, that an increase in the light reflected from objects gives rise to qualitative differences of gray or color, a fact which points to a peculiarity of the receptor apparatus for vision. It has been found to be possible, however, to observe under the "intensity attitude" visual differences of more and less.

Duration. The distinction has been drawn between a real durative attribute of experience called "progression" or "protensity" and the perceptive apprehension of "earlier" and "later," "before" and "after," "longer" and "shorter."[32] Much early work upon the "time sense" simply determined the aptitudes and the limitations of the organism for passing perceptive "temporal judgments." It goes down with other studies of capacity or of psychosomatic limit of function.[33] The durative aspect of experience has apparently served the organism in many ways in acquainting it with the temporal relations of objects and events in the physical world; but about this aspect itself we know little.

Extent. Many psychologists have set down "outspread" or "expanse" as a quantitative attribute of experience.[34] There are indications, however, both in the "volumic" property of tones and also in the pre-perceptive film colors (or color screens) that the real "extensive" attribute is a qualitative shading only, and that everything of a measureable

---

[32] J. N. Curtis, *American Journal of Psychology* (1916), Vol. XXVII, pp. 1-46.

[33] See p. 420 below.

[34] *E.g.*, H. Ebbinghaus, *Grundzüge der Psychologie* (1919), 4th ed., Vol. I, pp. 474*ff.*; E. B. Titchener, *A Textbook of Psychology* (1910), pp. 303-306.

spaciousness is a perceptive overlay upon experience. Certainly the "magnitudes," the "localities" and the "spatial patterns" of which psychologists often speak are qualifications of objects and not of experience itself.

Clearness. Another of the quantitative variables in experience is clearness or vividness.[35] The distinction of clearness degrees has arisen from the study of attention, and it is in connection with attention that this attribute is chiefly to be considered (Chapter vi). Wundt long ago spoke of the clarity and distinctness of processes held in the "focus" of attention; and it is obvious to all of us that the difference between bright "focus" and dull "margin" points to some difference which lies within experience itself. Experiment has shown that (1) clearness is observably different from intensity, and (2) it is possible to distinguish several degrees of clearness regarded apart from knowledge as a characteristic of experience itself.

V. Bodily Relations

Wherever and whenever we observe experience it appears to stand intimately and unequivocally related to bodily organs and to bodily functions. One aspect of this relation we have now to consider. This is the aspect which relates the qualitative moments of experience to the central nervous system, the nerves, muscles and receptor organs. In our brief discussion of those bodily members and functions, for psychological purposes only, an elementary knowledge of anatomy and physiology must be presupposed. This knowledge is to be found in the biological sciences.

Relation of the Experiential Qualities to the Receptors

Already we have made out a general connection between sensational qualities, on the one hand, and the bodily recep-

---

[35] Titchener has proposed the term "attensity" for clearness. *American Journal of Psychology* (1924), Vol. XXXV, p. 156.

tion of stimulus, on the other. Now we go on to indicate group by group what this connection is.[36]

1. *Visual Receptors*

The retina contains highly specialized organs, the rods and cones, accessible to light and connected with the optic nerve. These structures and their immediate surroundings are held to be the peripheral organs of vision. They appear to be the seat of reversible or "antagonistic" processes which condition the light and color qualities. The most tenable theory of their function makes the rods responsible for the light qualities (the gray system) and the cones for both light and color. Very weak illumination excites the rods alone (twilight vision); light of moderate and high energy both rods and cones. The shift in brightness (Purkinje phenomenon) appears to be due to the lapse, with decreased illumination, of function in the cones, the rods having a relatively greater sensitivity in the "green" than in the "yellow" wave lengths. Six distinct but interrelated processes, released or modified under light energy in the cones (the *R-G,* the *Y-B,* and the *B-W* processes), are proposed to account for the variety of hues; *e.g.,* the *R* and *Y* processes, in varying proportions, giving rise to the orange group, the *Y* and *G* to the olive group of hues, and so on. Tint and chroma differences depend upon many conditions, among them being the strength of the cone- and the rod-processes and the interaction of six (or less) of the retinal excitations in function at the moment. The interaction of the color-

---

36 Description of the various receptors and the theory of their functions may be found in the general physiologies, in monographs and in many current psychological texts. Examples are G. T. Ladd and R. S. Woodworth, *Elements of Physiological Psychology* (1911); W. H. Howell, *A Textbook of Physiology* (1921), 8th ed.; C. M. Jackson, *Morris' Human Anatomy* (1923), 7th ed.; and W. B. Pillsbury, *The Fundamentals of Psychology* (1922). Nothing in the way of detailed description will be undertaken here.

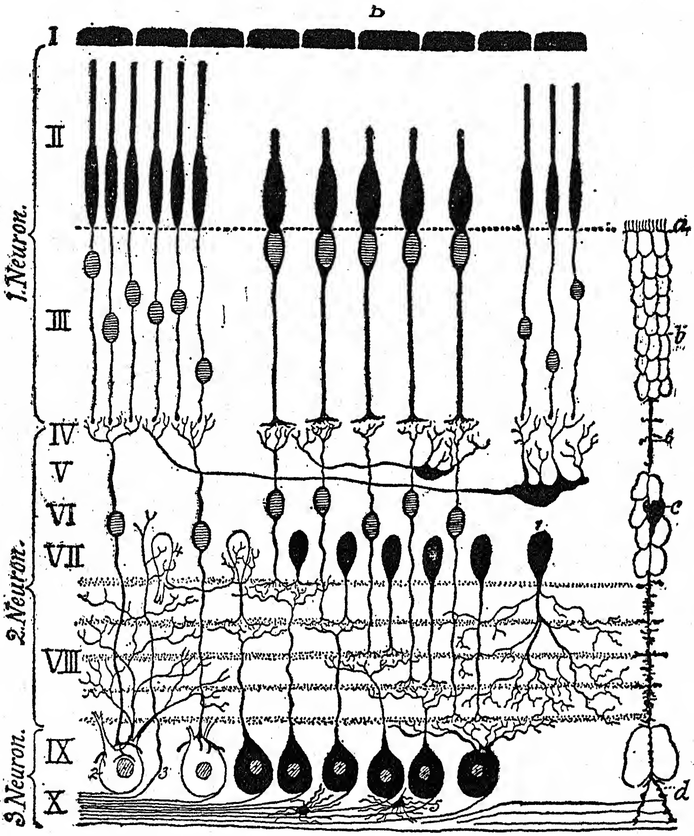


FIG. 9. SCHEMATIC REPRESENTATION OF THE HUMAN RETINA

The rods and cones lie in layers *II* and *III*. The rods, as are shown on the left, send impulses to the brain through fibers common to several of them. The cones, however, make connection with the brain, each through a separate fiber. From W. H. Howell, *A Textbook of Physiology* (W. B. Saunders Co., 1921).

processes in the cones varies all the way from complete antagonism (with the "complementary" colors) to almost complete support (with near-lying hues). Thus the laws of color mixture are made intelligible. The spatial distribution

of rods and cones (cones only in the fovea, chiefly rods at the periphery) is designed to explain the differences of central and peripheral vision; and the want or functional disturbance of certain of the color processes in the cones, the facts of partial and total color blindness. Adaptation is due to the progressive decrease in the receptor-function under stimulation; the negative after image, as well as general tuning, to the release of the antagonistic or reversed proc-

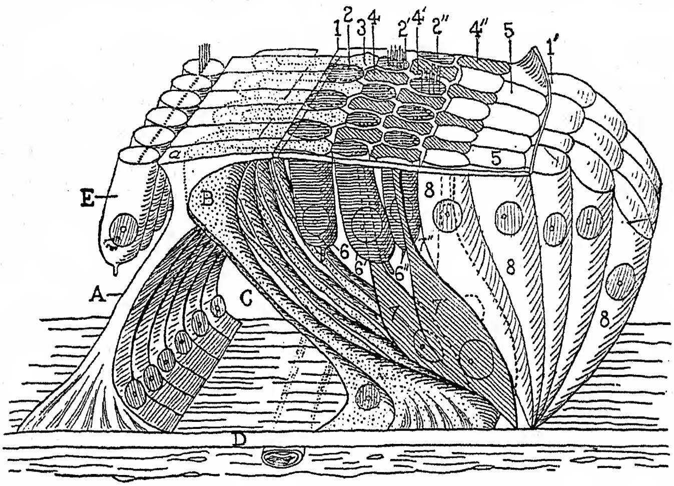


FIG. 10. DIAGRAM OF THE ORGAN OF CORTI

A, inner rods of Corti; *B*, outer rods of Corti; *C*, tunnel of Corti; *D* basilar membrane; *E*, inner hair cells; 6, 6′, 6″, outer hair cells. From W. H. Howell, *A Textbook of Physiology* (W. B. Saunders Co., 1921).

esses running parallel to adaptation. Thus our qualitative facts are referable, in the main, to a dual (rod-cone) organ which is the seat of reversible processes of a chemical nature. Many details of the structure and functions of the receptors are still under debate.

2. *Auditory Receptors*

The receptors responsible for the auditory qualities have for some time been known and described by the histologist.

(See the "hair cells" in Figure 10.) But the exact way in which the delicate terminals of the acoustic (VIIIth) nerve are thrown into function by sound-energy in the inner ear, and the way in which their excitation stands related to the qualitative variety of tone, vocable and noise, have both been matters of long discussion among anatomists, physiologists, acousticians, and students of psychology. The outstanding fact in tones is their analysis. It is obvious that the "hearing out" of individual tones from such a complex aërial disturbance as that produced by many instruments or voices calls for some organic means of recovering the component parts of the acoustical wave-train. The stimulus is one; that is to say, the air does not separately convey in vibrational form the displacement caused by each instrument or each voice. Only an algebraical resultant is produced. From this resultant some organic means must be found to account for the separate qualities which come simultaneously into experience. Up to a certain point of complexity the ear analyzes according to Fourier's law [37] which resolves the complex disturbance into simple pendular components, components which correspond, on the physical side, to the simple tonal qualities.[38] On the other hand, it appears that the complete analysis attained in tones is not attained in the vocable and the simple noise. Here analysis appears to be partial or incomplete and to lead to qualities which are attributively different from the tone. The difficulty, then, is to find within the tiny compass of the inner ear a receptor device which will ex-

---

[37] The law is thus stated by Helmholtz: "Any given regular periodic form of vibration can always be produced by the addition of simple vibrations, having pitch numbers which are once, twice, thrice, four times, &c., as great as the pitch numbers of the given motion." *On the Sensations of Tone*, A. J. Ellis, trans. (1895), p. 34.

[38] A sound so (apparently) simple as the note of the piano, flute, or violin is really made up of a series of these simple tones which can be separately "heard out" of the total note by the trained observer. We shall consider this "fusion" of parts when we come to organization.

plain this fact of tonal analysis and its limitations in the vocable and the noise. Helmholtz applied to the problem the physical principle of sympathetic resonance which is

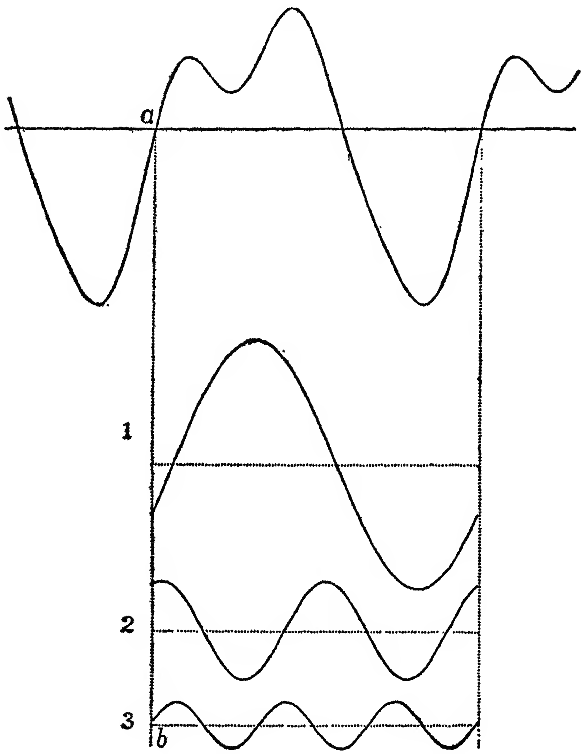


FIG. II. ABOVE, *a*, THE CURVE OF A VIOLIN TONE; BELOW, *1, 2, 3*, ITS PENDULAR COMPONENTS

From D. C. Miller, *The Science of Musical Sounds* (Macmillan Co., 1916).

illustrated by the selective vibration of a stretched piano string. When the proper rate of the string is supplied by an outside source (as by the voice or a tuning fork), the string is said to vibrate "sympathetically" to that source;

and it thus vibrates whether the source contains only its proper rate of energy transmission or this rate along with others. The basilar membrane of the cochlea is a thin plate of tissue with strong cross fibers stretched from the central bony shelf of the cochlea to the outer wall. These tense fibers vary in length and in mass. Helmholtz thought that they "sympathetically" vibrate, each with its proper rate, and in vibrating set into function the hair cells (*cf.* Fig. 10 above) adjacent to them. The various hair cells (the real neural receptors), of which there are many thousand, thus specifically "respond" in function to the various rates and so produce the tonal qualities. Noise, then, would arise from large masses of "unselected" cells with no—or only a gross—analysis. The vocable was not a separate problem for Helmholtz; for he considered the simpler vocal sounds as musical clangs with local emphasis upon some component partial tone.

The theory is beautifully simple; but it has met with many objections.[39] Several other devices, none of them wholly satisfactory, have been proposed. Instead of sympathetic resonance, the "telephonic" type of theory, which calls for a vast variety of vibrational patterns or figures spread upon the basilar membrane or some other part of the organ,[40] has been proposed in various forms. Some modified form of Helmholtz's theory, in spite of its difficulties, is still generally adhered to; but a more satisfactory account of the receptor functions is everywhere sought.[41] It appears likely that a definitive theory, when found, will show how gradations of analysis of the total energy impulse delivered at the ear can

---

[39] *Cf.* W. Nagel, *Handbuch der Physiologie des Menschen* (1905), Vol. III, pp. 562-572.

[40] The tectorial membrane lying above the hair cells has also been suggested.

[41] For a recent discussion of theories, *see* R. M. Ogden, *Hearing* (1924), pp. 30-47.

account for the attributive differences in tone, vocable, and noise; and will find, moreover, in the beating tone and the formant significant transitions from the simple tone to the noise, on the one hand, and, on the other, to the phonetic elements of speech.

3. *The Receptors of Taste and of Smell*

The receptor organ for taste, the taste bud, is a definite and fairly constant structure (Fig. 12). The taste buds are pear-shaped organs, containing parallel cells which end (at least some of them) at the moist mucous surface of the tongue in one or more pores through which protrude hairlike terminals. Here the sapient substance is supposed to excite the receptor. On the human tongue the taste buds usually occur in the side walls of papillæ of one form or another. The small, bright red fungiform papilla is easily recognized on the upper surface. Besides the dorsal and lateral surfaces of the tongue, some adjacent structures also contain the taste buds, which are, however, much more widely distributed in the embryonic and infantile stages of development. In the adult there is a long blank tasteless area at the center of the tongue's dorsum. At least a partial differentiation of function among the buds is suggested by various facts. One is that the tip of the tongue is most sensitive to sweet, the lateral edges to sour, both these regions to salt, and the base of the tongue to bitter. Another significant observation is that when the individual papillæ are separately stimulated by a bit of sugar, common salt,

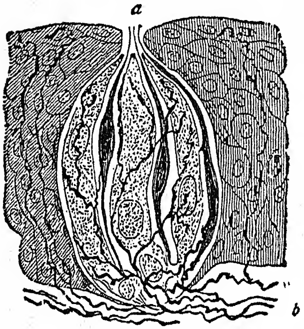


FIG. 12. TASTE BUD FROM A CIRCUMVALLATE PAPILLA OF THE TONGUE

A, taste pore; *b*, nerve fibers. From C. J. Herrick, *An Introduction to Neurology* (W. B. Saunders Co., 1916).

and so on, certain papillæ give rise to all four of the "corner" qualities, others to three, still others to two, and a few to one quality only. There is thus seen to be a correlation between the chemical substances acting as stimuli and the specific function of the various receptors. At least three nerves innervate the tongue and appear to share in transmitting the excitation from the receptors to the brain. The taste buds are widely distributed among the vertebrates, being present as far down as the amphibia. In certain fishes (*e.g.* the catfish) they are thickly distributed over the body surface and on the barbels as well as in the mouth. Similar nervous organs are also found among invertebrate forms.[42]

The neural element in the receptor for smell bears a general resemblance to the taste cell. It is a cylindrical or spindle-shaped cell (Fig. 13) lodged in the olfactory epithelium, a small patch in the upper part of the nasal respiratory tract. At the distal end of the olfactory cells are a few hairs, sometimes long enough to be called lashes or flagella.

These olfactory hairs are regarded as the real receptor organs. As they are bathed in watery mucous it appears that the chemical stimulus must be dissolved before it is effective for excitation.[43] Inasmuch as the hairs themselves are lipoid substances, insoluble in water, the chemical in aqueous solution would have also to be soluble—as it appears—in their oily substance in order to excite them. The fact that a vast number of chemical substances, often present in incredibly small amount, give rise to smell shows the great delicacy of the receptors. The presence in the olfactory epithelium of free nerve endings, believed to emanate from

---

[42] G. H. Parker, *loc. cit.* (1922), pp. 160-162.

[43] It is probable that smell in fish and other aquatic forms is mediated just as it is in man, save that the odorous substance is borne to the organism in water instead of being first dissolved in the nostril (Parker).

the trigeminal (Vth) nerve, is significant in connection with our remark (p. 81-2) that non-olfactory qualities must carefully be distinguished from smells proper. Sheldon [44] found that dogfish continued to react to oil of cloves, pennyroyal, thyme, and other substances in the nostril, after the olfactory

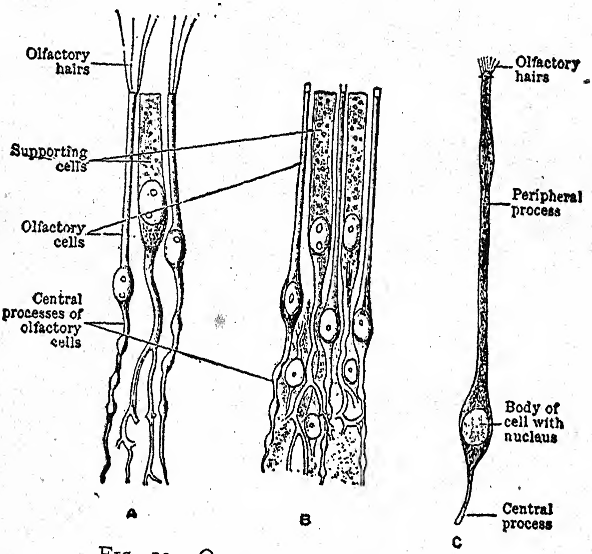


FIG. 13. OLFACTORY RECEPTOR CELLS

A is from the frog; *B* and *C* are from man. From C. J. Herrick, *An Introduction to Neurology* (W. B. Saunders Co., 1916).

apparatus had been destroyed, but failed to react when the trigeminal had been severed. The present writer is inclined to believe that the non-olfactory components still play a bad but conspicuous rôle in the determination and classification of smells.

No structural differences among the olfactory organs have been attested which might suggest a functional differentia-

[44] R. E. Sheldon, "The Reactions of Dogfish to Chemical Stimuli," *Journal of Comparative Neurology* (1909), Vol. XIX, pp. 273-311.

tion of smell classes; though the facts of partial anosmia (smell "blindness") and of the differential effect of exhaustion to a given chemical substance give a hint that there may possibly be a functional subdivision in these receptors.

4. *Receptors for the Somæsthetic Qualities*

A wide variety of devices for the reception of stimulus has been discovered in skin, muscle, tendon, and the visceral organs. Typical forms are displayed in Figure 14. In spite of obvious structural differences in these neural devices, not very much is known of the precise relation existing between them and the sensational qualities of the group. The best attested of these relations is the connection of the nerve twig about the root of the hair (*B*) and the Meissner corpuscle (*F*) with pressure qualities. It is probable that the nerve twigs upon the tendon sheath are concerned with tendinous strain and the muscle spindle with muscular pressure. The receptor organs in the muscle are stimulated both by compression from outside and by muscular contraction. The corpuscles of Pacini and Ruffini (*A* and *D*) may be receptors for cold and the Golgi-Mazzoni end-bulbs (*E*) may be concerned in warmth.

Although every sensational quality is probably dependent upon some receptor (in its simplest form, an undifferentiated nerve-ending) which is functionally modified by stimulus, we must not suppose that likewise every receptor is a "sense organ," *i.e.*, a mediator of an experiential quality. Some of the simpler reflex mechanisms are not, and excitations from the vestibular branch of the eighth nerve set up in the vestibule and in the semicircular canals (*e.g.*, by bodily rotation) seem not to be. The latter are closely related to the equilibratory functions of the cerebellum; but probably they do not directly condition any sensational item in experience. The "sense of dizziness" which is commonly attributed to them appears to be a bodily perception (*see* Chapter ix) made up largely of visual and pressure-strain qualities.

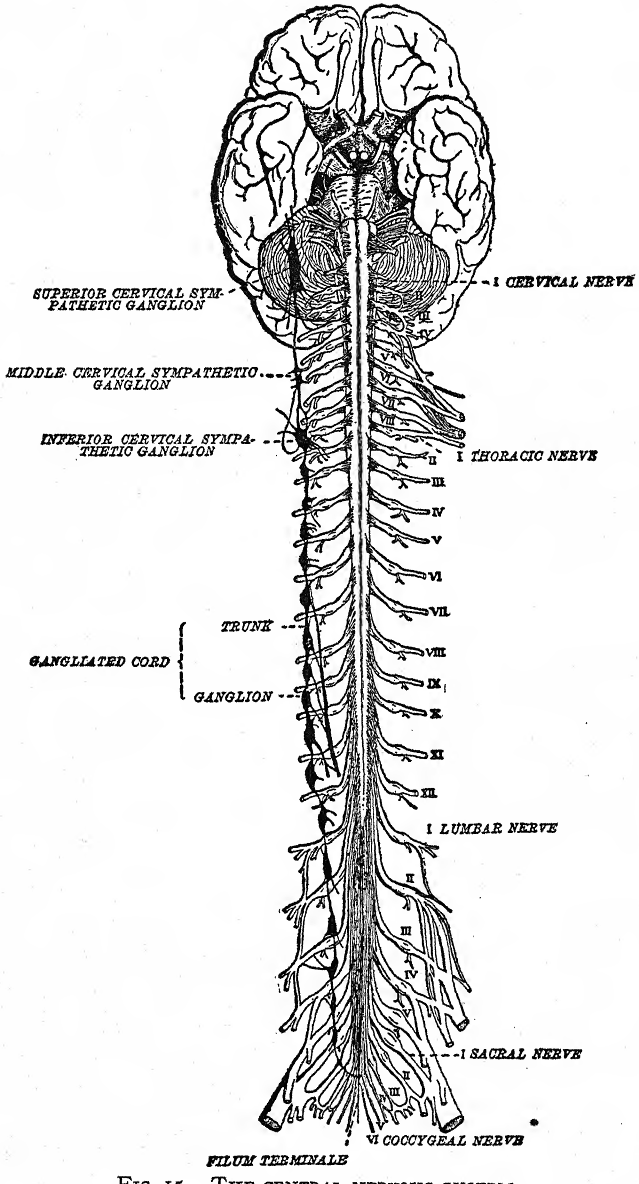


FIG. 15. THE CENTRAL NERVOUS SYSTEM

This shows the cerebro-spinal nerves and, in black, the sympathetic nervous system. From C. J. Herrick, *An Introduction to Neurology* (W. B. Saunders Co., 1916).

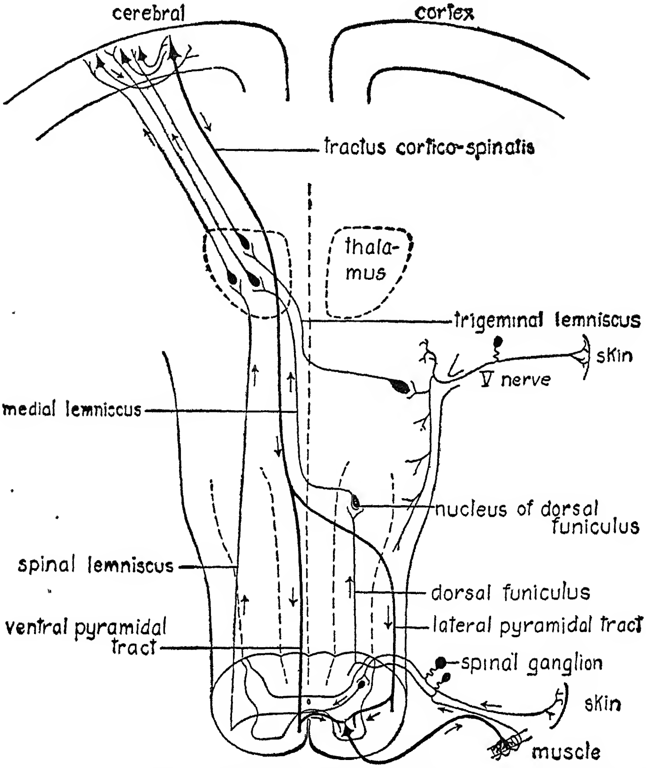


FIG. 16. ILLUSTRATING THE AFFERENT PATHWAYS EXTENDING BY WAY OF THE SPINAL CORD FROM RECEPTORS IN THE SKIN TO THE CEREBRAL CORTEX

motor pathway running from the cortex to a muscle is also shown. From C. J. Herrick, *An Introduction to Neurology* (W. B. Saunders Co., 1916).

5. *The Sensimaginal and Affective Qualities*

The sensimaginal qualities, depending primarily upon the central nervous system, call for no new receptors; and attempts to assign special organs or undifferentiated nerve-endings to the affective tones, pleasantness and unpleasantness, have not been generally confirmed.

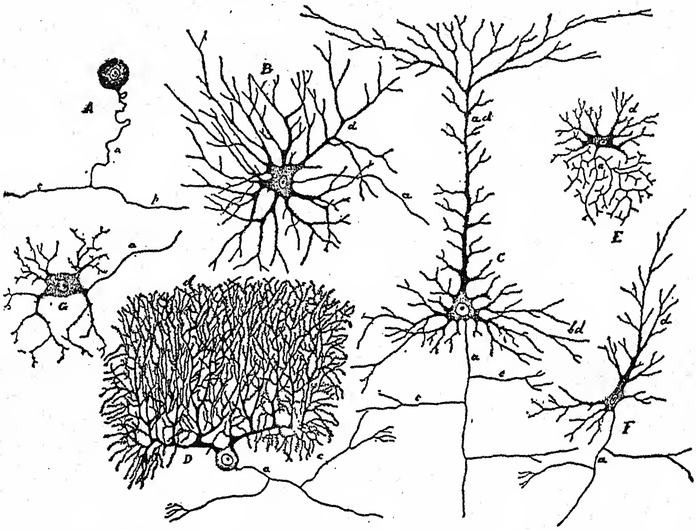


FIG. 17. VARIOUS TYPES OF NEURONE OR NERVE-CELL FOUND IN THE BRAIN, SPINAL CORD, AND NERVES

A, from spinal ganglion; *B*, from ventral horn of spinal cord; *C*, from cerebral cortex; *D*, from cerebellar cortex; *E*, from spinal cord; *F*, from cerebral cortex; *G*, sympathetic ganglion cell. From C. M. Jackson, *Morris' Human Anatomy* (P. Blakiston's Son & Co., 1923).

Nerves and Conduction Paths

The receptors would of course be useless were they not functionally connected with the brain. This connection is made through the afferent pathways which reach the brain by way of the spinal cord and the brain stem.[45] It is typically represented by Figure 16. The vehicle in the connecting tracts is supplied by the *neurone*, the structural unit of the nervous system. Each neurone is a modified cell. Processes, which project from the central cell-body, ramify in various directions and serve to connect the neurones with each other. The rule is for the nervous excitation to enter

[45] The olfactory nerve is an exception. Its fibers directly enter the olfactory lobe cephalad of the brain stem.

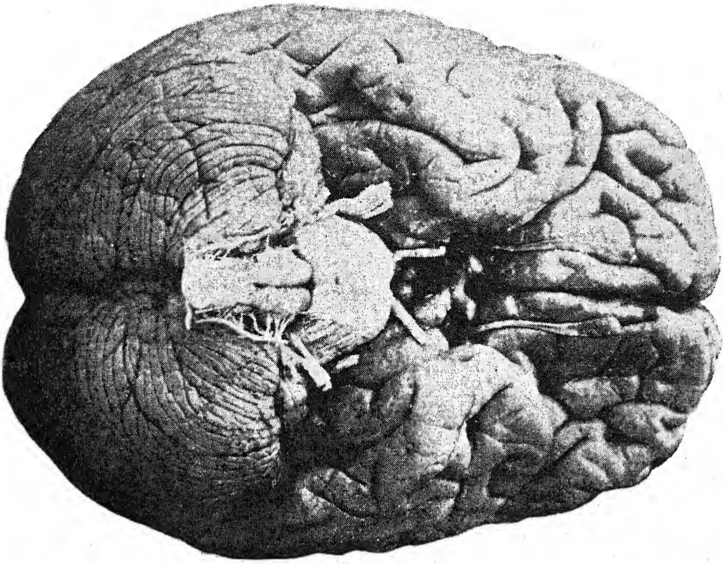


Fig. 18a. Basal view of the adult human brain.

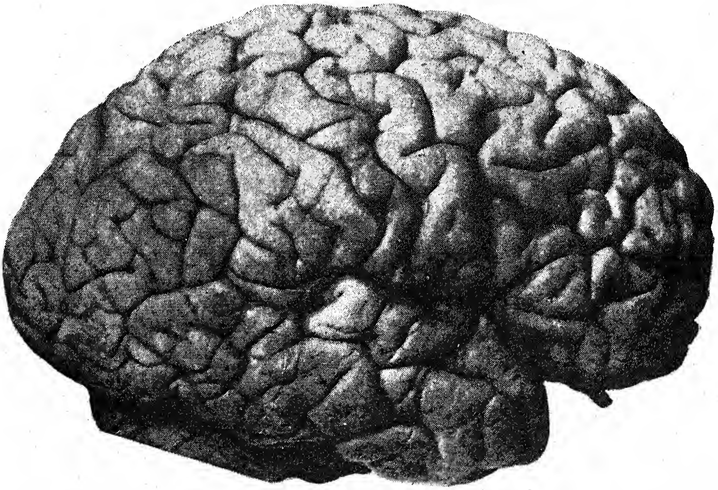


Fig. 18b. View of the right side of the adult human brain.
After Retzius, *Das Menschenhirn* (Stockholm, 1896).

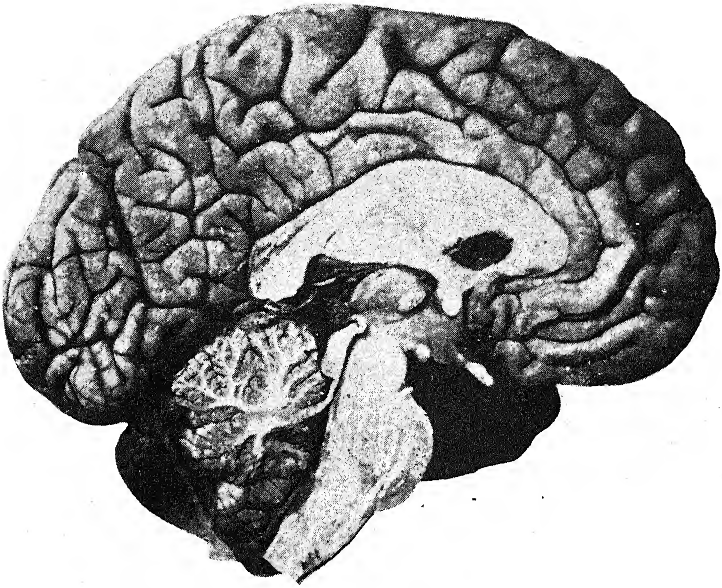


FIG. 18C. VERTICAL MEDIAN SECTION OF THE ADULT HUMAN BRAIN.

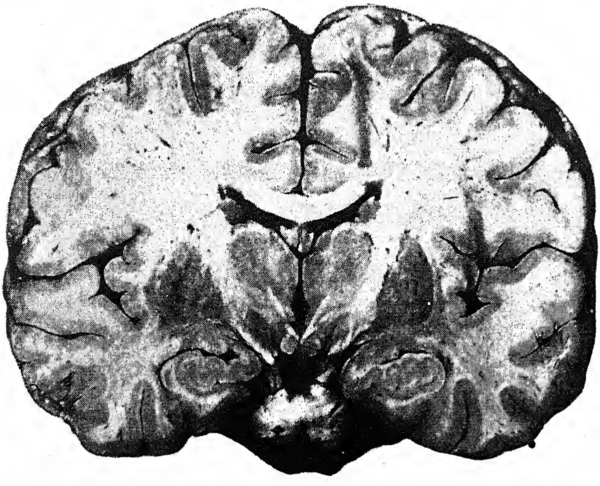


FIG. 19. TRANSVERSE SECTION OF THE ADULT HUMAN BRAIN, SHOWING THE WHITE AND GRAY REGIONS.
After Retzius, *Das Menschenhirn* (Stockholm, 1896).

the neurone over the dendrites (*d,* in the various types of cell represented in Fig. 17), pass through the cell-body, and leave by way of the axone (*a*).

For the greater part, the neurones in man are anatomically distinct. But they are functionally joined by contact or close approximation. The place where the axone of one neurone comes in functional contact with the dendrites of another is called the *synapse.* The synapse is important for neural conduction. A neural impulse passes in only one direction through the synapse, while it may pass in either direction over the axone. Moreover, the synapse offers resistance to the passage of the impulse and this resistance has been thought to be highly variable. It is now supposed that the neural impulse involves a wave of chemical change, associated with electrolytic action, and that its energy or intensity depends upon the number of nerve fibers excited (*e.g.,* by the spread or the strength of stimulus at the receptor).

The Brain

Neural impulses from the receptors, coming by way of the conduction pathways, constantly reach the brain in great numbers. The brain itself is a vast mass of neurones exhibiting regional differentiation and organized into functional systems of great complexity. Where the cell-bodies predominate, as in the cortex or "rind" of the cerebral and cerebellar hemispheres, the brain wears upon transection a grayish appearance (gray matter). Where the processes, bound together in fibrous strands, are in abundance (as in the great conduction paths) the substance looks white (white matter). The whiteness is due to the white (myelin) sheath which surrounds the axis cylinder. Three great tracts of the interconnecting fibrous systems have been described.

(1) The projection fibers, which connect the cerebrum and the cerebellum with the rest of the brain and with the

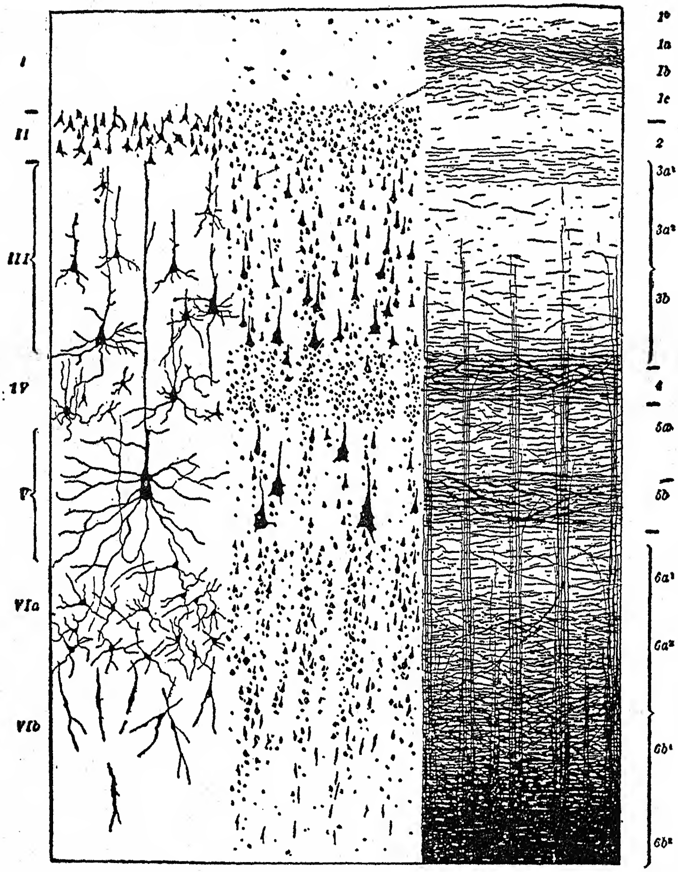


FIG. 20. ARRANGEMENT OF CELL BODIES AND FIBERS IN ONE REGION OF THE CEREBRAL CORTEX

On the left are two arrangements of cell bodies; on the right is the arrangement of nerve fibers according to Brodmann. From C. J. Herrick, *An Introduction to Neurology* (W. B. Saunders Co., 1916).

spinal cord, some of which are afferent (bearing excitations which may originate in the receptors) and others efferent (impulses outward-bound toward muscle and gland,

including the great pyramidal tract); (2) association fibers, which connect with each other the various regions of the cortex; and (3) the commissural fibers, stretching across from one half of the central nervous system (cord, cerebellum and cerebrum) to the other half. Many regional

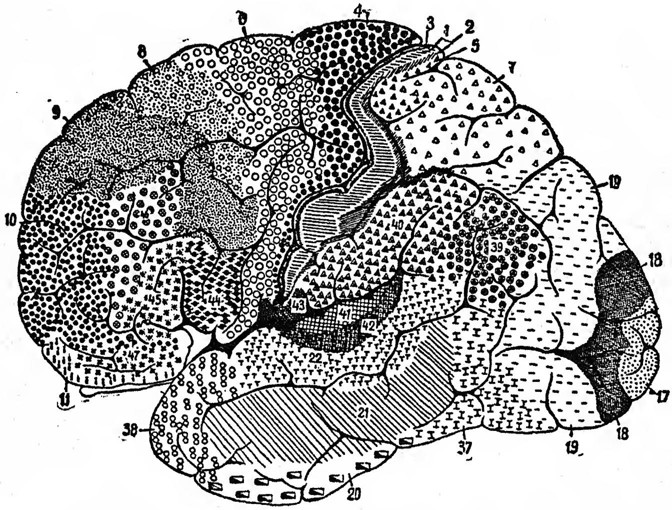


FIG. 21. MAP OF THE LEFT CORTICAL SURFACE OF THE BRAIN

The regional arrangement of cell body and process is according to Brodmann. Each area designated by a sign or number has a distinct lamination of its cells and fibers. From C. J. Herrick, *An Introduction to Neurology* (W. B. Saunders Co., 1916).

differences in type of neurone and in the successive layers of fibers and cell-body have been made out. One region in the cerebral cortex is shown in Figure 20.

Brodmann, who has mapped the cerebral cortex according to these areas, has observed a general correspondence between them and the regions where the large receptor groups are "projected" upon the cortex by way of the afferent fiber-systems. This similarity may be made out by comparing Brodmann's map (Fig. 21) with the same lateral view of

the cortex as laid out to represent the primary stations for these afferent tracts (Fig. 22).

The "visual area" (the cortical termination of the optic tract) lies in the occipital lobes, the auditory in the superior temporal, the tactual in the post-central gyrus, and the ol-

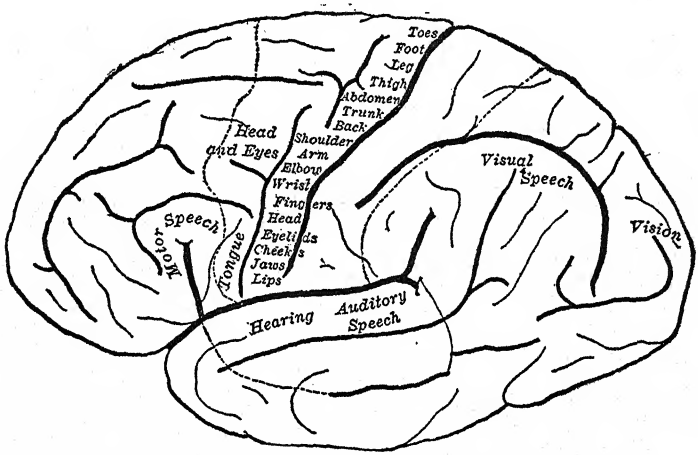


FIG. 22. FUNCTIONAL AREAS, SENSORY AND MOTOR, LAID OUT UPON THE LEFT SIDE OF THE CEREBRAL CORTEX

From C. J. Herrick, *An Introduction to Neurology* (W. B. Saunders Co., 1916).

factory in the hippocampal region. That similar direct connections with the muscles are maintained has been shown by the electrical stimulation of the cortex. When closely circumscribed, stimulation is followed by the contraction of a muscle or a small group of muscles. The chief "motor area" lies just before the great central fissure (the precentral gyrus; area 4, of Brodmann's map in Fig. 21). The exact topography of this region has been laid out by Sherrington upon the chimpanzee and other apes, and also confirmed by other methods.

Now we must not assume that sensations and sensimages

are "lodged" in circumscribed areas, or that one area only is functionating when we visually perceive, another when we listen, another when we visually remember, and so on. While a given projection area controls the immediate and direct connection with a group of receptors or muscles, the total cortex, which is integrated in a very close way, functionates as a whole, though with focal areas of special emphasis, without doubt, and with a wide variety of functional patterns. Certain areas within the cerebral cortex are not directly connected either with the afferent fibers or with the great motor outlet in the precentral region. These areas have been called "association centers"; but numerous attempts to recognize in them the seat of the "higher mental processes" or of "associations," taken in the psychological sense, have not succeeded. While they are doubtless of great importance to the functional integrity of the brain and especially to the rapid modification of function involved in the processes of habituation, of "learning," and of our psychosomatic functions, we have no evidence that they are the specific "seats" or "centers" of anything mental. These areas are relatively larger in the human brain than in any other animal form. It is probable that they are essentially concerned in the elaborative and comprehending functions and in certain forms of perception, memory, imagination and action. So far as we can tell, however, they add nothing to the *qualitative variety* of experience, unless, perhaps, they are responsible for the sensimaginal factors.[46]

---

[46] Many attempts have been made to account for the "imaginal" qualities in experience. The best articulated of these (M. F. Washburn, *Movement and Mental Imagery* (1916), pp. *27ff.*,) invokes the influence of the "motor" regions upon the activity of the primary "sensory" stations in the cortex.

PART II

THE ORGANIZATION OF EXPERIENCE

CHAPTER IV

ORGANIZATION UNDER STIMULUS AND RECEPTOR

Analysis and Organization

Earlier in our survey we insisted that the mere enumeration of individual parts and aspects of experience, no matter how exhaustive and accurate, does not complete the psychologist's description. Experience is always organized; it is coherent; its terms always stand arranged or grouped in definite and significant ways. Mental description—if it is to be adequate—has then to regard its materials in a synthetic as well as in an analytic manner. It has to look to "architecture," integration, constitution, as well as to individual parts or members. This is a fact as fundamental as are the individual constituents themselves. Were it not an observable fact, we should be justified in assuming it; for coherent knowledge and considered action would scarcely be possible with an inchoate and unorganized experience. We supplement, then, our treatment of the attributes of experience with an account of the integral unities.

That experience furnishes real and important problems on the side of integration, problems which take us beyond the individual aspects and qualities, may be readily illustrated by a bit of tuneful melody or a spatial figure. The tune remains the same whether played or sung, whether set high or low, whether run through upon the violin or the cornet. That is because the essence of the tune rests upon the fixed relations of the successive notes and not upon their qualitative character as individuals. So, too, the spatial figure is possessed

of the same "squareness" or "triangularity" whether drawn in white or colors or scratched in the sand; whether seen, traced blindfold in a groove or described in the air. Place, size, materials, sense organs, and the specific qualities of experience which these things condition, are not, then, the essential factors in the tune and the figure. The essential factor is the unity of the integrated experience itself; and this unity cannot be resolved (except for the purposes of analysis) into a mere sum of the integrated parts.[1]

The Simpler Integral Forms and Their Conditions

A convenient key to organization is supplied by the conditions under which the qualitative items of experience come into existence. These conditions are of two general kinds; (1) organization under stimulus, where concomitant welding or temporal ligation is chiefly determined by events which lie outside the nervous system and affect it by way of the receptors, and (2) organization under central tendencies, where the observed unity is determined by central or cerebral events standing in partial or complete independence of stimulus and of the immediate operation of the receptors.

---

[1] The fact of unitariness has been described and explained in many different ways since the Austrian psychologist Ehrenfels pointed it out in 1890 (*Vierteljahrsschrift für wissenschaftliche Philosophie*, Vol. XIV, p. 249) and alleged that it rested upon a new kind of "consciousness," the "form-quality" (*Gestaltqualität*). The proposal was elaborately discussed for more than twenty years (*cf.* M. Bentley, *American Journal of Psychology*, 1902, Vol. XIII, pp. 269*ff.*; A. Gelb, *Zeitschrift für Psychologie*, 1911, Vol. LVIII, pp. 1*ff.*). Within the last decade the *Gestaltqualität* has been replaced by the doctrine of the *Gestalt*, which finds in the unities of perception and elsewhere an ultimate and unanalyzable datum not to be resolved into part-qualities or members. This doctrine must be taken within its own setting; for it implies a thorough revision of many of the fundamental categories of psychology. *See* K. Koffka, "Perception: an Introduction to the *Gestalt-Theorie*," *Psychological Bulletin* (1922), Vol. XIX, pp. 531-585; W. Köhler, *Die physischen Gestalten in Ruhe und in stationären Zustand* (1920); E. Rubin, *Visuell wahrgenommene Figuren* (1921).

Our best instances of the first kind of condition are furnished by perception, where experience is unified under the environmental circumstances of the moment.[2] That my experience includes at this minute visual and auditory qualities arranged in a certain definite way is due to the passing of a motor car before my study window. A spatial pattern of light-stimulus moving across the retina and a complex sonorous disturbance transmitted through the air from the motor engine to my ear unequivocally determine the arousal of a visual-auditory formation which—taken with additions which we may at present neglect—*mean* the passing car.

In order to guard yourself against a misunderstanding, make it perfectly clear in your own thinking that no total experience is ever for a moment entirely determined from without. No nervous system, whether of the human or of an infra-human kind, is so naïve and so passive in its operations as to suffer its functions to be wholly and solely controlled by outside forces and agents. The nervous system has its history written deep within it, its individual and its racial history; and its history is always a co-determiner of the operations which run their course within the brain. At the same time, certain forms of mental structure are *primarily and essentially* set and fixed by stimulus, as certain other forms are primarily and essentially set and fixed by central or cerebral tendencies toward function. So we can, without confusing or distorting the facts, separately consider the two kinds. We must remember, however, that in so doing we are abstracting from the *total* experience of the moment, although not to the same extent as when we were observing and describing the single and simple moments and ingredients.

[2] Perception itself is a functional matter which is to be treated in quite a different context (Chap. ix). Here we are only concerned with the integrative aspects of experience, and we appeal first to perceptive materials only because these are suitable and representative.

The Three Types of Primary Incorporation

When we regard those mental formations which most clearly represent the direct impress of environmental conditions, those formations which are least dependent upon antecedent functions of the nervous system, we find that they are of three general kinds; qualitative, temporal, and extensive. The first kind is represented by the hearing of a musical chord, the second kind by a rhythm or a melody, and the third by the perception of a stained glass window. It requires but little inspective skill to assure oneself that, quite apart from the individual qualities which enter into the perception of the chord and the perception of the melody—to take first the first two kinds—there is a difference in the *plan of arrangement.* The qualities are somehow differently organized, differently integrated. In the chord we find tonal processes which are blended into a characteristic whole. Take the common chord represented by the notation *c–e–g–c′*. By a little practice any one may assure himself that the *c* is "there," and the *e,* and the *g,* and the *c′*; but they are not "there" in just the same way that they would be if each note were sounded separately. As they stand together they are more "retiring," less obtrusive; and, moreover, each contributes to the total chord. By using the figure of men who unite for certain commercial purposes, we may say that the parts are incorporated. The members of an incorporated company may remain individuals; although each makes his contribution to the unitary whole. They are many and still one. That is the secret of organization. The analogy is not fanciful. We may speak of the individual notes in the chord as "members" of the incorporated whole. Under the synchronous action of stimuli there do arise these natural unities which occupy a conspicuous place in the architecture of experience. These are the qualitative incorporations; sometimes also called "fusions." To realize that they are not to be regarded simply

as plural "sensations," as heaps or totals, we have only to note that the chord is the same common chord whether the incorporated members are *c, e, g,* and *c′*, or *d, f♯, a* and *d′*, or *f, a, c′*, and *f′*. Within limits, the same tonal incorporation exists so long as fixed relations are maintained in the stimulus.[3]

Let us return now to the comparison of the chord and the melody to consider our statement that these complexes represent ultimately unlike types of incorporation. If you will hum any simple melody or pick it out upon the piano, you will immediately realize that here too the separate notes "stand together" in a natural and characteristic way. But here they are "tied" or "ligated" in sequence to form the second or *temporal* kind of incorporation. For the sake of an intimate comparison with the chord, you may compose a simple melodic phrase by combining our four notes thus: *e–c′–g–c*, *i.e.*, mi-do(high)-sol-do(low). Sound the notes in this sequence upon the piano and then, by way of contrast, strike them all at once. The complexes are essentially different. The individual members are the same; but they occupy different "places" in the incorporations according as you arrange the stimuli in a simultaneous or in a successive pattern. It is, in fact, upon the double basis of these two types of incorporation that the structure of our modern music has been built. Eastern or Oriental music, which uses chiefly the temporal or "melodic" type, neglecting the rich possibilities of the simultaneous or "harmonic" form of tonal integration, has taken quite a different direction.

The chord and the melody represent, then, unlike modes of organization. These modes are, however, no more unlike each other than either is unlike the third kind of incorpora-

[3] In connection with the doctrine of the *Gestalt,* W. Köhler has sought to demonstrate the existence of characteristic stimulus configurations underlying certain unities of experience. *See* his *Die physischen Gestalten in Ruhe und im stationären Zustand* (1920).

tion, the kind represented by the perception of the stained glass window. Here the color qualities stand related in a novel way. They do not "fuse" and "interpenetrate" as the notes in the chord do, and they are not "ligated," not connected "end-to-end," as the successive sounds of the melodic phrase are. There is a "side-by-sideness" about them that is characteristic. This sort of incorporation we shall come to know as the *extensive.* The three forms taken together give us the three elementary modes of organization.

Dependence of the Primary Incorporations upon Stimulus

When, on an earlier occasion, we were considering the dependence of the attributive qualities upon the properties of the stimulus, we discovered that, within limits, sensational quality (blue, gray, salty, stain, etc.) corresponds in general to the different kinds of stimuli (light-waves, chemical processes in the tongue, compression in the tendon, etc.) as well as to differences in receptor organs (cones and rods, taste buds, tendon spindles, etc.) Now we have further to make out a similar set of correspondences, not for individual items this time, but for their typical modes of organization and it is reasonable to expect as many forms or "manners" of organization as we find ways of combining stimuli and of uniting separate receptors in a common function. Let us see whether this "reasonable" view is supported by the facts.

When we examine the properties or peculiarities of the physical and chemical agents which serve to excite the receptor organs, we discover certain attributes which are common to all of them. These are *mode, intensity, extent* and *temporal course; i.e.,* the stimulus is mechanical, photic, acoustic, thermal, etc. (mode); it is strong or weak (intensity); it is confined to a small group of rods and cones, extended over the whole retina, or limited to a single cutaneous hair (extent); and finally it endures a short or a long

time, is steady or interrupted, periodic or irregular in sequence (temporal course). Now each of these properties of the agent exciting the receptor has, as a matter of fact, its effect upon the character of our organizations. Consider the properties in order.

Mode comes first. Such an incorporation as the chord among sounds is also found among smells (the complex odors) and among the "organic" processes in hunger and thirst. This type is known as the "fusion" because its members are rendered obscure in making their contributions to the unity of the entire group. Expressed in other words, the "manyness" of the group is less conspicuous than its "oneness." The members are fused while, at the same time, they preserve characteristic relations to one another. But fusion does not take place under the visual mode of stimulation and only under special conditions (*e.g.,* the fusion of heat and pain in the "burn") in the tactual senses. This type of incorporation has also been called "qualitative" because the qualitative interpenetration of the members gives to the incorporation its peculiar "fused" character.

Within a single sense, minor variations of mode may materially affect the closeness or the looseness of the fusion. The most striking instances of this dependence are to be found within audition, where the closeness or the *degree* of tonal incorporation is primarily determined by vibrational ratios. A vast amount of experimental labor has been directed toward the discovery of the dependence of degree of fusion upon vibrational ratio. The problem is exceedingly difficult. Its difficulty rests chiefly upon the fact that "fusion" may be taken by the observer in many ways. The observer may report upon sheer qualitative simplicity under a searching "attentive" attitude. This is the fundamental test of qualitative integration. Or he may observe the qualitative unlikeness of the members. Again, he may be impressed by smoothness or roughness; by the unitary "volume" of the totality;

by such non-auditory accessories as "rotundity" or "softness," or finally by the æsthetical property of "harmoniousness." The application of the essential criterion of simplicity requires high training in the observer. The greatest infringement upon quality (*i.e.*, the greatest loss in clearness) appears where the vibrational ratio-numbers are the smallest; the octave (1:2), the fifth (2:3), the fourth (3:4), and the least infringement (among the ordinary musical intervals) where the numbers are relatively large; the minor sevenths (8:15, 9:16). That this qualitative integration is not based upon nearness or remoteness in the tonal series is clearly shown by the fact that the octave and the sevenths (near-lying intervals) stand at opposite ends. The inspective evidence points toward a loss of pitch "saliency" in fusion. The co-presence of two tones appears to damage each on the side of the pitch attribute. But precisely what this change under integration signifies will require a careful comparison of simple and dual qualities under separate observational attitudes for pitch, volume and brightness, as well as for sheer simplicity. Whether this type of qualitative amalgamation is tending toward the formant and the noise, as Ogden thinks, awaits further experimental investigation.[4]

Another instance of the dependence of fusion upon the interrelations of stimulus is the vocal sound. The wide resources of human speech largely derive from the fact that tonal and noise qualities coalesce into a great number of characteristic "fused" incorporations; those represented by the letters of the alphabet and their simple combinations. The larynx and buccal cavity sounding together give rise to a complex of periodic and irregular vibratory movements of the contained air which produce the tone-formant-noise fusions

[4] *Cf.* W. Kemp, *Archiv für die gesamte Psychologie* (1913). Vol. XXIV, pp. 139-181; C. C. Pratt, *American Journal of Psychology* (1921), Vol. XXXII, pp. 490-515; and R. M. Ogden, *Hearing* (1924), pp. 123-149.

of speech. In describing the simple vocal sounds in the last chapter, we discovered that the formant is a dull, soft accompaniment to the fundamental, whose pitch attribute is retired and obscure. This fusion of formant with fundamental and partials characterizes the vowel sounds, while the consonantal

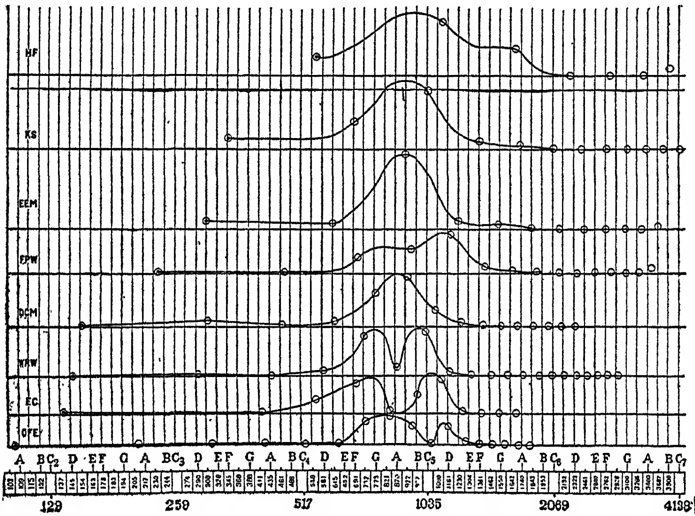


FIG. 23. DISTRIBUTION OF PHYSICAL ENERGY FROM EIGHT DIFFERENT VOICES PRODUCING THE SAME VOWEL

The eight different voices were pronouncing the vowel *a* (as in *father*). The loop in the vicinity of 900 vibrations represents the physical side of the formant or "characteristic" for this vowel. This general region is constant; although the eight sounds are intoned on fundamentals ranging from 106 vibrations (bass) to 522 vibrations (soprano). From D. C. Miller, *The Science of Musical Sounds* (Macmillan Co., 1916).

units generally add noise components and a characteristic temporal course.

A third instance of dependence is furnished by "clang color." The peculiar and characteristic sound of a given musical instrument is due to the fusion of tones of fixed pitch-relations, to which are added various noises incident to the scrape of the bow, the wheeze of the pipes, the thud

of the drum sticks, and the like. Music regards the note, with its characteristic clang color, as ultimate in composition; but it is, as we now see, really a closely fused mass of individual members incorporated in a definite and definable way.

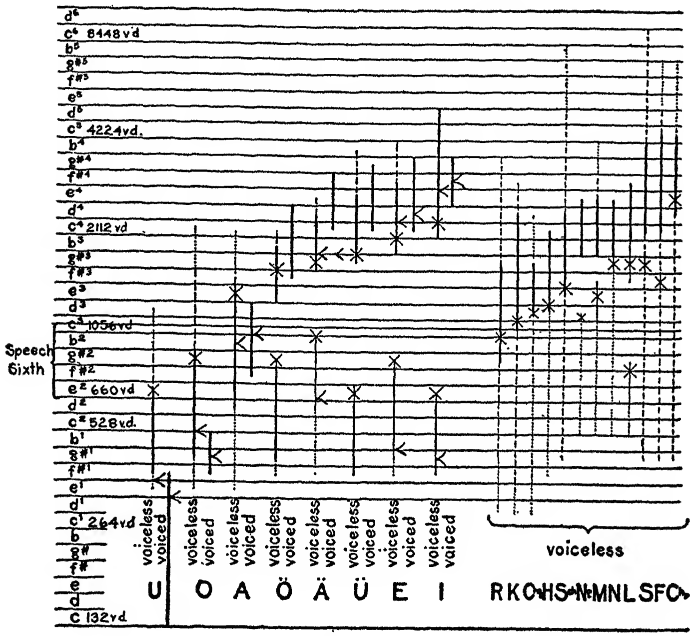


FIG. 24. THE PLACE OF THE PRIMARY FORMANTS (HEAVY VERTICAL LINES), SECONDARY FORMANTS (LIGHT LINES), AND CHARACTERISTIC PARTIAL TONES (CROSSES) IN MANY VOWEL AND CONSONANTAL SOUNDS

From R. M. Ogden, *Hearing*, (Harcourt, Brace & Co., 1924).

The intensity of stimulus also plays a part in incorporation; but its part is rather to emphasize certain members than to create a new sort of connection. It makes certain members prominent and certain other members inconspicuous. Like variations in mode (such as we have just now described in

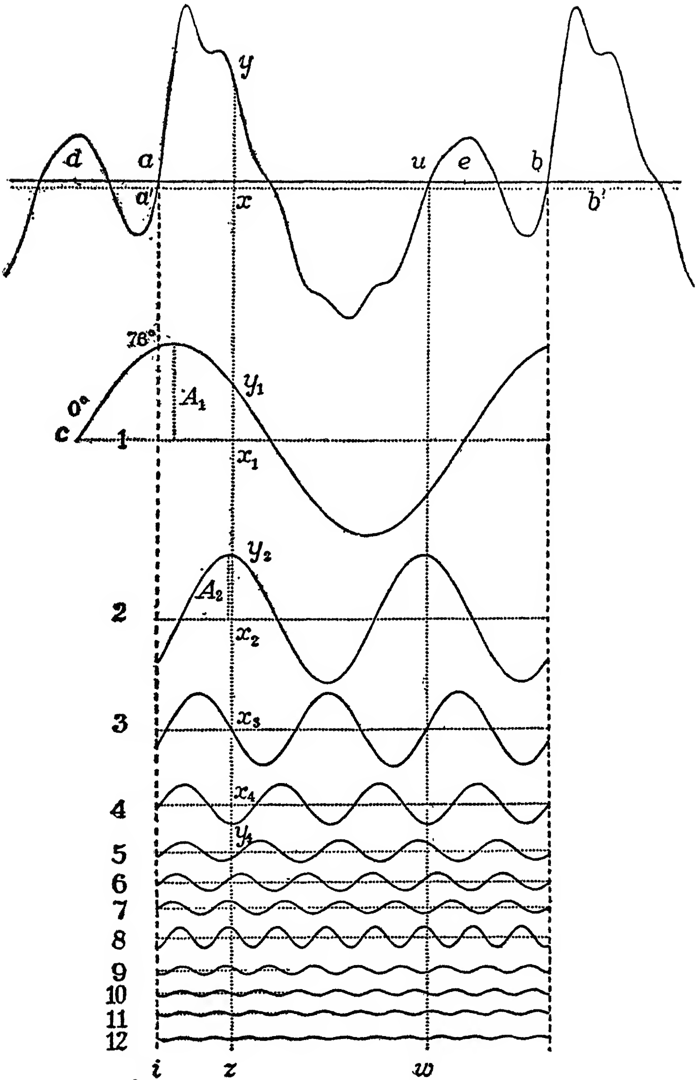


FIG. 25. AN ORGAN PIPE CURVE AND ITS HARMONIC COMPONENTS

The upper curve represents the total displacement caused by the pipe. The lower curves show the total resolved into its twelve components representing the relative vibration rates, 1, 2, 3, 4 . . . 12. Each component corresponds to a simple tone. The fusion here is very close and the dominant pitch is that of the fundamental, 1. From D. C. Miller, *The Science of Musical Sounds* (Macmillan Co., 1916).

tonal fusions), intensity exerts an influence upon the *degree* of incorporation. In the note, *e.g.,* one tonal quality, the fundamental, is relatively strong; the remaining sounds, the overtones, relatively weak. The strong component "carries" the note, defining its pitch-place in the musical scale and determining melodic structure. A similar effect of intensive differences appears in the arts of the florist and the perfumer. A pleasing olfactory complex may be provided in the bouquet or the synthetized perfume, where one or two components are strong and emphatic, while other weak components serve only to give piquancy or "coloring" to the whole fusion.

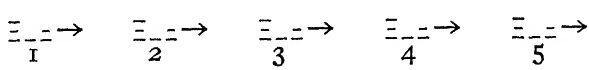
The extent and spatial distribution of stimulus offers the third kind of support to the unitary structure. It underlies, in fact, an unique kind of arrangement, our *extensive* type of incorporation. You have but to glance at a row of books upon the shelf or at a pattern in the wall paper to realize that here visual qualities (reds, grays, blues, browns, etc.) have been combined in a way that is quite unlike the incorporated tones and noises in the note, in the chord, and in the vocal sound. The colors of a picture do not, as we have seen, interpenetrate. They remain somehow "outside" each other. And nevertheless they "go together." One group of colors taken all together stands for a human figure, another the sky, and so on. That is to say, once more, that as the qualities stand integrated they *mean.*

You will realize upon reflection that this kind of incorporation plays a part in our apprehension of the spatial attributes and the spatial relations of objects in the physical world. "Knowledge" will concern us when we come to speak of perception, memory and thinking; and the study of its origin and development will be reserved for the history of mind.

We return to the extensive incorporation itself. You will clearly appreciate what is included in this kind of organization if you will suddenly glance at an inverted picture with

which you are not wholly familiar and then at the same picture without inversion. So far as the visual qualities are concerned, the two experiences are the same. But when you look at the uninverted view the parts are somehow snapped together. The snapping, you must be warned, does not itself take place in experience. That is a matter which the body looks out for. The members stand arranged, conjoined, ordered; and as they so stand they *mean*. In the inverted view the integration is almost wholly lacking, and in consequence the meaning of the picture is wanting. To be sure, a part of the reason for this difference in integration lies within the central nervous system, a region which we have not yet explored for conditions of mental organization; but that fact will not disturb your present comparison of these two like groups, one of which is closely incorporated and the other of which stands relatively loose and amorphous.

The temporal factor in stimulus, regarded as a condition of organization, is left for our scrutiny. It is of very great importance. It produces—as we have intimated—an unique type of integration. In the melodic phrase we have already considered an instance of the way in which members stand united when they are successively initiated. The tonal group *e–c′–g–c* is not a mere string of separate tones. It possesses unity, coherence. In a real sense it is one. The same may be said of the elements or beats of a rhythmical measure. Three even clicks given thus upon the metronome, click, click, click, and repeated several times, arouse a sequence of auditory sensations whose "formal" or integrative aspect may be represented as follows:



The whole "line" is a structure. It contains within it five parts, rhythmic units or "feet," each of which has characteristics distinguishing it from every other. Not only has each

sound in the unit its own prominence or accent (strong, weak, moderate, in our instance); variations in prominence, from foot to foot (1, 2, 3, 4, 5), make each foot, as the rhythm grows, an unique and individual member of the whole structure. To rearrange these members or to modify their character would precipitate a change in the entire rhythm. It has been found by experiment that, within limits, the longer the periodic recurrence of stimulus continues, the closer is the integration and the greater the individuality and the meaning of the rhythmic object.

Over and above the mere repetition of neural excitation at the receptor, the stimulus makes other temporal contributions to the establishment of the rhythm. While repetition is usually sufficient, provided a fairly constant interval is maintained between successive strokes of the metronome, a regular alternation of intensity or of vibration-rate within the stimulus series, such as

STRONG, weak, weak STRONG, weak, weak, etc.

or

Low, high, high Low, high, high, etc.,

serves to strengthen the organization and to take over functions in rhythmization which are otherwise left to the control of the nervous system. It is this sort of encouragement to rhythmization which is provided in dancing by the large drums in the orchestra.

There is still another contribution made by stimulus to the temporal incorporation of rhythm. Most, though not all, rhythms include a bodily factor. The body itself contributes, in the contraction of muscle and the pull of tendon, experiential qualities of alternating intensities which help to put the succeeding members into their places. It is in large measure this bodily factor which is responsible for the knitting up and the individualization of the rhythm just indicated.

Our account of these temporal incorporations, illustrated by rhythm and by melody,[5] would lack an essential part of the description did we not go on to affirm that the individual members of the rhythm and the melody do not exist merely within the temporal place indicated by the stimulus. In the rhythmical unit,

SOUND→sound→*sound,*

we do not have one quality running its course and dying, only to be succeeded by another, and this in its turn by a third. The sounds exist *together.* And their togetherness is plainly related both to the fact that when the strokes or the notes come too slowly the integration is wanting and also to the fact that the togetherness is increased as the rhythm goes on, the members becoming more and more closely integrated. In rhythm and in other temporal incorporations the structure, which is at once one and many, wears a curious and unique aspect. As *one,* the thing is together; as *many,* its members stand articulated in time. Instead of the qualitative interpenetration and the spatial standing-aloofness displayed respectively by the fusion and the extensive type, we find here a *temporal* interpenetration and at the same time a temporal disjunction. It is a little like the clock-dial, which is present all the time while the hours and the minutes nevertheless appear only in their prescribed sequence and order.

It is clear that this curious feat of lasting-over without fusing with its successors, which we have discovered among temporally incorporated members takes us somewhat beyond our external conditions; though it is obviously based upon the temporal relations of the successive and discrete stimuli. We can, then, go no further in our present direction, for we are here regarding only the *primary* incorporations, *i.e.,* those immediately dependent upon stimulus. We should, however,

[5] In the melodic sequences of music, a fixed basis and fixed pitch relations (intervals) are added to rhythm.

before we pass from stimulus to central conditions, see whether the receptor can add anything to our remote or "external" antecedents of the organized groups.

Dependence of the Primary Incorporation upon the Receptor

As we have seen, many of the members of the qualitative incorporations are supplied by audition and smell. If we examine the receptors here involved, we shall find that they are so lodged beneath the surface of the body as to be inaccessible to any arrangement of stimulus which corresponds, point for point, to places or localities in the environment. Consider first the organ of hearing. It provides, to be sure, for the exhaustive analysis of massive and complicated stimuli; but the analysis is not of the "spatial" kind. Assume a large orchestra with all its instruments momentarily in function. The resulting incorporation will include a very large number of members, possibly fifty tones and noises. These stand organized for a moment before the conductor passes to the next note in the measure. These fifty-or-so qualities do not, however, correspond to any arrangement in space. The sound-object is not a spatial object. No "extensive" incorporation is formed. A similar statement could be made for a smell-fusion or for the complex in giddiness set up by whirling upon the heels. In every case a qualitative incorporation or fusion results. The case is quite different with respect to vision and the cutaneous senses, the organs of which are set mosaic-wise in the retina and in the skin. Here the arrangement of receptors corresponds to the pattern of stimulation, and the pattern of stimulation corresponds in turn to the disposition of surrounding objects.[6] The resulting incorporation is generally of the extensive type. Here, then,

[6] The sensitive mosaic of the retina, impressed by the light-pattern of the retinal image, and binocular disparity present, of course, the most clear-cut instance of the conditions here brought under discussion.

the receptor seems to be an important condition of the arrangement of processes which inspection discovers in the organization of experience.

As for the points of emphasis within groups, which we have found to be controlled in part by the intensity of stimulus, little can be said for the organs standing at the gateways to the nervous system, *i.e.*, for the receptors. Here and there we do find that these organs play a part, as in the intensification of high tones, which brings into prominence the upper or "soprano" voices of fusion, the high tuning of the eye for certain wave-lengths (the greens and yellows), the variations in sensitivity within and without the fovea, the selective processes in visual and olfactory adaptation, and the like. These are, however, matters incidental to our present inquiry.

Finally, the rôle of the receptor in the temporal incorporation may be summarily reviewed. The chief relevant fact is contained in the observation that the successive type of organization requires, in its simplest form, a receptor which is readily set into, and thrown out of, function for the production of clear-cut and well-defined processes. The chemical organs of taste and smell are, it is evident, badly adapted to this end. Hearing is the chief resource. The sum total of rhythmic and melodic incorporations and the vocal articulations of speech indicate the generous contribution of this sense. Vision and somæsthetic receptors do contribute, through the temporal perception of movement; but principally upon the basis of certain extensive incorporations which signify the spatial relations of objects.

Significant and concordant relations obtain, then, between the incorporated forms of experience, on the one hand, and the properties of stimulus and receptor, on the other. But we must not straightway conclude that the unitary structures of experience possess the same kind of unity and the same type of relation to be found in receptor and stimulus. The concurrent existence of the mental qualities is no more "re-

ducible" to the physical and physiological concurrences than the individual qualities themselves are. The incorporations are fused, ligated, interpenetrated, and "configured" in their own peculiar way. This fact is fundamental. We shall not fully appreciate its significance until we discover that experience makes its unique and essential contributions to all the operations and performances of the psychosome.

The Place of Tendinous Strain in the Incorporation

This quality is produced under some movement of the body—by the lifting of the arm, the wrinkling of the forehead, the straightening of the shoulders or the setting of the mouth and throat in speech. During perception we are constantly carrying out movements of various sorts, some of them designed to adjust the eye or the ear to the stimulus; some of them—as in moving the head—designed to keep the object within sight or hearing; some of them manipulative, *e.g.*, the movements of the hands in examining, exploring and analyzing objects; some imitative, and some of them responding to any demand which the object or the event perceived may make upon the organism. These movements are, as you will readily understand, of great importance in perception, and it is reasonable to suppose that they occupy an unique place in the simpler integrations which we are now considering. Let us analyze a case in which the quality or qualities derived from such movements form an integral part of the incorporation.

As I sit by the window watching the street, I see a huge block of ice slip from the iceman's tongs and fall from the wagon to the pavement. The ice I perceive as blue and cold and smooth and heavy and as falling dangerously near the feet of the straining deliveryman. Regard analytically the perception. We speak of it as "visual"; it is in fact only partially visual. It is organized upon the basis of visual qualities; but the brain also makes a contribution which is just as im-

portant and just as constitutive as is that of stimulus and receptor. The central contribution is, in fact, double. A part of it comes by way of the organs of movement—muscles and tendons—and another part of it by way of sensimaginal processes centrally aroused. Let us consider, for the present, the first—the kinæsthetic—part of the central contribution.

As I watch the iceman I find that I am myself making imitative movements. My back straightens; I start as if to rise; my arms become slightly rigid; there is a tendinous pull from the cheek and jaw, and my breath is at first held and then suddenly released. All of these movements, whether they are overt or only incipient, are initiated by way of the brain. Ultimately, of course, they must be referred to the stimulus-pattern upon the retina, for the whole perception rests finally upon the eye. But so prompt is the contraction of muscle and the pull of tendon that the kinæsthetic factors appear in time to be organized in the "visual" perception. They are an integral part of it. They contribute to its dynamic aspect. It is chiefly through them that the ice "looks" heavy and the iceman appears as struggling with his unwieldy burden.

Now psychologists have at times maintained that every actual perception includes this supplementary kinæsthetic factor which we have just now found in our incorporation. Those psychologists who are inclined to emphasize the "motor" side of mind have maintained that perception always involves the residues of movement of the body; that it is only as the organism responds to, adjusts itself to, the object that the perceptual meaning arises. For them "stimulus" and "response" are correlative terms, and the chief task of psychology they are apt to regard as the description and explanation of the various ways in which the organism acts or "behaves" in adjusting itself to the environment. A general discussion of this "behavioristic" point of view which has been imported into psychology from biological studies may be

reserved for another occasion. Here it is only necessary to ask whether, as a matter of inspective fact, perceptual incorporations (1) always include the kinæsthetic factors initiated by movements of response or adjustment, and, in addition, (2) always include them as essential and significant parts of the perception. It is entirely possible that kinæsthetic moments may be present upon such perceptual occasions and nevertheless be excluded from the perceptual incorporation and play no part in the apprehension of the object. It is a case of setting logic and argument against observation; for the behaviorists have never substantiated by careful inspective evidence the invariable presence and the perceptive relevance of these kinæsthetic processes; although they have cited occasional instances (similar to our heavy impending block of ice) which clearly reveal kinæsthesis. They have usually argued, however, on general grounds, that the nervous system was designed to adjust the organism to its surroundings and that therefore its primary use was to innervate the muscles.

You should accept with caution these general arguments. It is true that the nervous system has grown up in intimate relations with the developing apparatus for adjustment; but it does not follow that all its functions or indeed its most essential and representative functions in man are concerned with organic movement. The sole outlet of a lake may be the flume which supplies the saw mill; but the lake is not, on that account, to be solely identified (save, possibly, by the owner of the mill!) with the means of turning the mill wheel. Its waters saturate the ground and yield vapors to the air; it is the abode of aquatic life; the scene of currents and eddies; and the resort of the fisherman, the oarsman, and the artist. The nervous system has, notably in the higher vertebrates, grown steadily away from the primitive direct linkage of receptor and muscle; and the elaboration of a central system standing in partial independence of these terminal organs is of the first importance to experience.

The Place of Affection in the Incorporation

Thus far our description has taken account of the integration of only one of the qualitative classes, the "sensational" class. We have still to consider the affective processes and also the sensimage, so far as these depend upon stimulus and upon the receptor. We first consider the affections.

Do pleasantness and unpleasantness make any contribution to the "architectural" side of experience? Do they enter as members into the incorporated groups upon which perception, memory and imagination rest? The presence of an affective moment in our apprehension of objects is at times undeniable. Objects "strike us" as pleasing or forbidding, as charming or ugly. A column which easily supports its load is "comfortable"; a tilted or unstable column affects us unpleasantly. The affective qualities appear also to be involved in our apprehension of colored objects, of sounds, of odors, of the contact of the hand with a cold railing, and of heavy and unwieldy objects. And this is as true of memory and imagination as of perception. But when we try to describe the relation of the affective *quale* to the integrated forms with which we are now familiar, we meet with a difficulty. They refuse to be "composed." In the chord *c—e—g—c′* each tone has its obvious place; but we cannot make the same observation regarding the pleasantness of the chord. To write the incorporation *c–e–g–c′–pl* hardly expresses the inspective fact. In some cases, no affection is, as a matter of fact, present. An affective "judgment" is passed, but without a real affection. The object is pronounced to be pleasing or admirable or forbidding or disturbing; but the "feel" appears only in the meaning. These spurious cases we may leave out of account, and consider only those where pleasantness or unpleasantness is actually present. Here we must again regard the nature of the affective process itself. We have observed that it has no "place" in experience; that it is not a localizable

item. It is spread, so to say, as a fog or mist or sizing or varnish is spread over the land or over a picture. It appears to be for this reason that affection does not enter into combination; that it is wanting in those individual relations which the other qualities sustain toward each other. The pleasantness of the chord or the unpleasantness of the dissonance does not then add one more member to the complex; and, at the same time, the chord would somehow be differently "colored" or "toned" if it were of the opposite affection.

For our present purposes, it is only necessary to observe that our incorporations are at times charged or suffused or overlaid with pleasantness or unpleasantness; and that, when they are, the affection gives a characteristic coloring or toning to the complex. The affections do not, however, form incorporations, neither do they enter as members into the incorporated groups. Affective suffusion is, in spite of this incapacity, of primary importance, as we shall later see, in supplying a basis for that kind of meaning which we shall come to know as "value." We shall also find it to have a peculiar significance in the emotive functions.

Organization of the Primary Incorporations among Themselves

It is obvious that the small groups which we have examined under the three unitary kinds of incorporation do not exhaust unity at large. While we listen to the melody we may also read the words of the song or beat out with the hand an accompanying rhythm. The fusion of the chord may be followed by a whole train of other harmonic combinations. The extensive incorporation of the picture may be followed by twenty or fifty others of like order as we make our way through the art galleries. When we scrutinize the face of an acquaintance we may also press his hand in salutation and listen to his greeting. It is safe to say that no single incorporation of the compact and unitary kind that we have

considered ever for a moment "fills" experience. It is a natural unit to which meaning attaches; but it runs its fluent course side by side with others and in temporal sequence with them.

At present our only concern with these multiple formations is the manner in which they subsist in consensual groupings and sequences. Are the incorporations like moist snowballs which may be packed into large masses, or like cannon balls which present external configurations in the pile without, however, suffering deformation or fusion? Do they conjointly form incorporations of the same kind but of greater complexity, or do they run their independent courses without synthesis or mutual interference? In answer to these questions we may observe that inspection distinguishes three cases.

1. *The Coalescent Incorporation.* Consideration of the first case leads us to the fact that two or, at times, all three of the classes of incorporation (qualitative, temporal and extensive) may be represented in a group of qualities which present, taken all together, the same general form of integration as we have previously described. Such a combination stands at the basis of the ordinary perception of movement, where a successive train is integrated with the extensive incorporation of visual and somæsthetic members. Almost any "spatial" formation may, when it undergoes an appropriate change, give rise to the apprehension of movement. This inclusion of a temporal ligation among qualities which are "extensively" incorporated is illustrated by the electric sign which represents such an object as the moving arm or an eagle in flight. Two sets of lights arranged to give the outline of the object at two different positions produce, when they are alternately illuminated, the perception of a swinging movement. The same type of coalescent integration underlies the cutaneous perception of movement. If a small toothed wheel, with deep notches between the teeth, is rolled by means of a forked handle over the skin, the successive tactual im-

pressions are conjoined into a "movement" complex; although each impress of the skin is stationary, the wheel is apprehended as running in linear fashion from one place to another. Here again we see that under favorable conditions this sort of incorporation is produced in the absence of an actual lateral displacement of the object along the sensitive surface; and here, as well as in visual movement and in rhythm, the kinæsthetic factor plays an important part in ligating the whole group of qualities and in giving rise to the perceptual meaning.

2. *The Constellated Incorporation.* This type of unity within experience underlies a total perceptual situation. As I enter the druggist's store and observe in a general survey shelves, bottles, current magazines, clerks, customers, the opening of cases, a characteristic odor, and the hum of speech, many samples of all the individual incorporations which we have been describing form and reform to compose a total experience and to bear a rich but unitary meaning. In a real sense the whole experience is one.

3. *The Incorporate Train.* Besides these closely knit organizations, in which we have the same type of consolidation as is found in the simpler structures of the melodic phrase and the simultaneous tonal interval, we discover in experience, as it is integrated under stimulus, a large number and wide variety of looser formations which run their course as we go about our occupations hour after hour. The first and richest class of these formations is the incorporate train. When I visit an acquaintance in the country I am sometimes taken in his car to inspect the farm and woodlands. As we ride from point to point there is a kaleidoscopic alteration of the scene. But it is, in a measure, all one scene; and when we return I realize that my apprehensive experiences have flowed without a break for the short hour which has just passed. A vast number of qualities have run a connected and fluent course which suffers a break as we enter the house and

yields to a new set of interests. These trains occupy a prominent place in our waking life. Between the psychologist's concern for the individual "process," on the one hand, and his absorption in the "association of ideas," on the other, this type of integration has not received its due.

On the side of organization, such trains as these are less compact, less closely amalgamated, than the smaller incorporate groupings which enter into them. Nevertheless, they are not to be regarded as just heaps and masses and strings of "sensation." Not only is the hour's ride *one*, so far as it followed a continuous road and meant an hour's single recreation; it is *one ligated mass* of experience which may upon a subsequent occasion supply a connected train of "ideas" in retrospect. We shall presently find that it furnishes not only the materials, but also the typical connections for those associated groups which underlie our "free" ideas of memory and imagination. Their bodily conditions differ. The perceptive trains which we now hold under our scrutiny are put together primarily under the influence of stimulus. A multitude of receptor organs are, during the ride, played upon by patterned and regularly sequent forms of stimulation; and to these forms we must chiefly trace our primary perceptual knowledge.

But while the continued and consistent play of stimulus is, as we have just seen, the *primary* cause for these conjunctive trains, it is not the only cause. While we apprehend objects and events about us, we are also active in a bodily way. We turn our heads as we ride; we prepare our eyes and our ears for the best reception of stimulus; we brace ourselves in the car and we sway at the turns. As in the case of rhythm, the somæsthetic elements so aroused flow on in varying intensities and with constantly shifting qualitative changes, forming a matrix in which the whole is imbedded. We have only to observe the break in a train when a general motor set is suddenly changed—as in giving up the

attempt to hear in a large and noisy auditorium—to realize how these fluent and ligating additions must hold together and mold the perceptive experiences.

These bodily contributions to synthesis lead us still another step away from the external conditions. The turning of the head, the intent fixation and the brace are all symptoms of a general *set* or *determination* which marks the readiness of the central nervous system for certain specific functions. It is necessary here to call attention to their existence in order that we may observe their influence upon the sort of integration which we are discussing. The brain is never wholly neutral as regards function—never at least during waking hours. It is always the seat of trends; and if we look carefully and analytically into experience from time to time, we shall be able to discover there the symptoms of these general bodily dispositions.[7]

[7] Some adherents of the doctrine of the *Gestalt* maintain that such patterns and structures as our incorporations are simple and ultimate units of experience with a primary dependence upon cerebral, not external conditions. They stress the *one* and ignore the *many* in organization. This they are encouraged to do because they seek the unitariness of *perceptual function* rather than the bare organization of raw experience.

CHAPTER V

ORGANIZATION UNDER CENTRAL CONDITIONS: ASSOCIATION

The Secondary Incorporation

In our treatment of the primary incorporations we have traced the typical forms of integration to differences in stimulus and receptor. We have found, as a matter of observation, that our complexes varied under variation of the outside conditions. Now we go on to the inspection of a class of complexes which are, at the moment, independent, in whole or in part, of stimulus and of receptor but which ultimately derive from this same source. These complexes are commonly known as "images"—images of memory, of imagination, of expectation, and the like. As I now consider in memory a certain painting by Carpaccio I note that it bears an obvious resemblance to the Arundel print which I may perceive if I lift my eyes to the walls of my study. So, too, the new melody which I make up or imagine "in my head" as I sit here by the open window and the actually rendered melody which I shall pick out presently upon the keyboard in the adjoining room. We see—as we say—the unseen picture "in our mind's eye" and we hear the unplayed tune "in the head." But what can we say about the corresponding and underlying experiential qualities and about the manner of their integration?

The individual members are, of course, the sensimages which we already know. Although they arise without stimulus and without a call upon any receptor apparatus, they are in their character like "corresponding" sensational qualities. We therefore commonly know them as "visual" and "tonal," as "kinæsthetic" and "organic" images. In the second place,

when we examine the collections of them, which make up the "total images" signifying the objects and events remembered or imagined, we discover that the pattern of integration also is the same as that of the corresponding primary incorporation. The original impress of the organism lasts over and now determines the type of complex upon which a memory or an imagination is founded. We may therefore speak of these small imaginal complexes as *incorporations* because they are of the same kind as those which we have described, and as *secondary* incorporations because they are, so far as their plan goes, replicas of the primary kind. The organism having once been impressed by the physical and chemical agents which play upon the receptors, the imaginal processes appear without the constant recurrence of the original external conditions, and they stand united just as the "primary" qualities stand, in the qualitative, the extensive, and the temporal forms of integration. The impress of the environment is, then, not simply momentary. It determines both the qualities and the organization of subsequent formations, and thus it extends its molding influence upon the entire constitution of experience.

At the same time, we must not lose sight of certain notable differences between the primary incorporations and the secondary kind. In the first place, the two kinds have, as we have observed, different references. The secondary incorporation may serve as a memory, *i.e.*, it stands for an object or event which is past. The imaged face is recognized as the face of an acquaintance as seen a fortnight ago, the imaged painting as the print upon the wall, and the bit of tune is part of a popular air once heard upon the street or at the dance. One of the principal uses of the total image is then to supply persons and scenery for the stage of memory. Another use is imaginational. The total image refers to a scene or an event which has as definite a setting as the memorial setting, but with a different context. The context is

that of phantasy. This use of imagery is common as we read books and dream daydreams and plan houses and holiday excursions. It makes no reference to one's own past; instead it fabricates objects for a fanciful or ideal or possible or fictitious or future scene or event; and at times it is a mere anticipation, as when we image the approaching street car before it appears around the corner. There is also another, a third, way in which the total image is turned to account. It is to be found in the image of general reference. If you will review your imagery of "knife," "pin," "stove," "horse," and other like objects, you will commonly find that there arises a visual or auditory fragment which stands, not for a particular knife, pin, and so on, but for *any* object of its class. The reference is general; it is neither a memory nor an imagination. It does not mean an individual object, and nevertheless its meaning is wholly definite and precise. These secondary groups, which want all particularized meaning, are very useful (as we shall see when we come to speak of ideas and of thinking) just because they permit us to get away from the minutiæ of the world and to consider certain general aspects of it.

Here, then, are three distinct kinds of reference which are implicit in the secondary incorporation, memorial, imaginational and generalized; three general directions in which these incorporations bear a meaning or a significance. You might well expect to find that the integration of the three kinds had somehow taken different courses; that simple qualities compounded in one way made memories, in another imaginations, and, in a third, stood for a generalized object. Inspection does not, however, bear out the supposition. The general manner of construction of them all appears to be the same. The same hand of nature has laid its impress upon them. A fusion may make a memory, an imagination, or a generalized object; and the same is true of the other two types.

But a difference of another sort is to be found. To speak in general terms, the memorial images [1] are, as a rule, those most like the corresponding perceptual form. If you can now recall "in image" the melody or the rhythm which you recently examined, or recollect in visual terms the inverted picture, you will find that the present total images reproduce with a good deal of faithfulness (item for item) the original experience. Some of our total images are almost exact duplicates, both as regards their individual members and also as regards their organization, of corresponding primary groups. I hear again the clatter of the cymbals at the end of a florid orchestral passage. I see the red-blue disks with which I worked yesterday in the laboratory. I experience again the exciting rise and drop in the fire siren. Except for the context, it is as if the physical agents were at this moment attacking my visual and auditory organs. Under certain conditions, then, the central nervous system may replace, almost completely, these outside conditions of organization. But if to-morrow you were to examine one of those "fresh" memories, you might find it less definite and less faithful than now. In fact, one form of forgetfulness is due just to the breaking down within the group of the natural connections originally established under the pressure of stimulus. Try to reinstate, in imaginal terms, the exact arrangement of dishes and silver upon some table where you have dined but once. If your observation is carefully made and if you succeed in visualizing the table, you will find gaps in your

[1] The term "image" has been so persistently used to stand for something mental, of the same sort as "sensation" and "feeling," that the reader will have constantly to remind himself that it is an "object" term, of the same temper as "perception," and not therefore the name of any "mental" or experiential process. Its significance for psychology will more clearly appear when we advance to the functional problems of memory and imagination. The text here and there retains the adjective "imaginal" with the existential meaning of "sensimaginal."

imagery, gaps which you will automatically fill in from other sources to make your "memory" complete and logically correct. The knives and spoons which you do not "see" you may create for the occasion, placing them in conventional order at the side of the plates; while your table companions are much more likely to be immediately represented from the original grouping of visual qualities. Where the union is of the extensive kind it tends to become simplified and to change into conformity with an image of general reference which the individual "carries in stock." [2]

This breaking down of the integrated mass is of importance for mental development, as we shall see in due time. The decline of the memorial meaning supplies many elements for the schematic complexes of general reference which we have already examined. It also furnishes the raw materials for reincorporation in those complexes upon which the imaginations are based. Scrutiny of the scenes and faces which entertain you as you pursue the adventures of your hero or heroine in an interesting novel will convince you that your own imaginal embellishment of the story is largely drawn from old total images which continued to serve as definite memories so long as they retained the original stamp of the primary incorporations. Thus a ruined fort which the writer once vividly "saw" as he read a thrilling adventure of Cooper's Leatherstocking turned out to be an obsolescent and decayed memory of an abandoned adobe house actually visited many years before.

We must stop for a moment to remind the reader that

---

[2] E. R. Jaensch has recently (*Zeitschrift für Psychologie*, Vols. LXXXIV-XCII) defended the theory that the original secondary incorporation was this photographic replica of the primary kind—a sort of permanent perceptual after image, which he calls the "eidetic image." He sustains his belief by appeal to children and animals where he seems to find these incorporate units, which he looks upon as the antecedents of other forms of image. We return to them in our genetic account of experience (Chap. xix).

memory and imagination are really functional matters. The total organism, drawing at once upon its mental and physical resources, manages to apprehend objects as past and as imaginational. The proper treatment of these functions is reserved for the psychosomatic sections (Part III); but, as matters stand, it is impossible to expound our centrally controlled incorporations except by this functional means of identification. So inadequate is language! What chiefly concerns us now, however, is the integration of our complexes; and when these latter are once identified, we must abstract just as far as we can from their objective reference.

The Mixed Incorporation

We have recently found, in the secondary incorporation, a type of mental synthesis in which the central organs play a prominent part. The total image immediately rests, as we have repeatedly observed, upon the fulfillment of certain necessary conditions within the brain. But the total image has been found to suggest the same kind of integrative unity as the primary incorporation, and this generic likeness we have explained by the fact that its members have, as a matter of history, been welded into their present unity by stimulus and receptor. Now when we come to the consideration of similar complexes which contain *both* "sensations" and sens-images, we may still regard them in the same way, although they depend in part upon central, and in part upon peripheral, conditions. To the mixed incorporation the receptor organ and the central organ pay joint tribute.

In our instance of the block of ice falling upon the street, the coldness and the smoothness of the ice had to be accounted for by sensimaginal factors, because our observation revealed the presence of just these appropriate materials. When I scrutinize the experience I discover that the "cold" meaning is based upon an imaginal cold and the "smooth" meaning upon an imaginal pressure. As I looked from my window,

I seemed to see the coldness and the smoothness; but there was no visual "cold" and no visual "smooth." These depend, in our case, upon somæsthetic qualities. When I lay my hand upon a cake of ice a thermal quality (cold) and a tactual quality (pressure), of a given intensive pattern, arise. But when I only *see* the ice, these tactual qualities may be supplied in sensimagery. When they are thus supplied, as in our illustration, they fuse so closely with the visual sensations as to lose their usual mode of reference and to belong, incorporate, to the total "visual" perception.

Now there is a very old tradition in psychology that all perception involves the assimilation of "sensations" to images or antecedent "ideas." Here again fact has been subordinated to theory. The "mind" has been thought of as coming out in an active way to meet and to assimilate the incoming sensations and to inform them with significance. Belief in such a process requires mental powers which are purely hypothetical; but the actual integration of sensations and sensimages does at times occur, as we have observed in our instance of the cold and smooth ice. Visual perceptions are *frequently* supplemented by imaginal elements from the "bodily" senses. We see velvet as soft, steam as hot and porcupines as prickly. Again, the auditory apprehension of objects, as sounds heard in darkness and conversation at the telephone, is supplemented by the "looks" of the object. But the universality of such imaginal completion has by no means been demonstrated. Both of the theories of indirect completion of our perceptions—by way of the innervation of the muscles and by way of sensimages—overlook the aptitude with which all sorts of qualities acquire and transmit meaning. The soft "feel" of the velvet curtain *seems* to require the "tactual" senses; but often it *does not.* The visual complex may itself mean softness or warmth or weight or yieldingness. These qualities of the curtain have previously been acquired by contact; but, later, vision stands as

a real surrogate for touch and takes over the offices of the original experience of manual exploration. Mind is full of short-cuts to meaning. A new meaning is usually borne by an elaborate qualitative variety; but gradually the materials are reduced until only tags are left. That is not to say, however, that the meaning undergoes a like decline. It may, on the contrary, increase as the vehicles which originally bore it undergo foreshortening and ellipsis. This fact is illustrated by the significance which we come to attach to slight facial changes and vocal inflections in an intimate friend. When we observe the facility with which the blind and the deaf attach meanings commonly borne by the visual and auditory sensations to substitutive qualities, we are well nigh persuaded that the particular mental vehicle of any meaning is largely a matter of convenience and sometimes almost a matter of chance. But we shall better understand these facts under consideration when we come to see what essential part the body plays in these operations.

The recent distinction drawn between the preperceptive film colors (the primitive "screen" or "curtain" qualities), on the one hand, and various perceptive modifications, the "bulky" transparent colors of colored liquids and hazes, the surface colors overlaid upon solid objects, the mirrored colors reflected from polished surfaces, and so on, well illustrates the manner in which a general functional set of the cerebrum may create perceptive reference and modification in sensational qualities without actually adding new sensimaginal factors. It is likely that most early perception, both in the individual and in the race, derives its significance rather from this central "tuning" than from the addition of new sensimaginal qualities.[3]

Again, the use of verbal symbols well represents the extent

[3] Read D. Katz, *Die Erscheinungsweisen der Farben* (1911), and M. F. Martin, *American Journal of Psychology* (1922), Vol. XXXIII, pp. 451*ff*.

to which elaborate meaning may be attached to this or that slender thread of experience. Five words of conversation thrown upon the screen in explanation of the action in a moving picture may carry immediately and without aid the whole turn of the plot. The same may be said for the auditory symbols of which we make use when we listen to the conversation or to a lecture. Instruct an acquaintance to repeat over and over a single word—such as "fortune" or "biped"—while you listen with closed eyes. You will soon discover that the meaning "wears off" while the sound remains. Finally, the casual way in which men pass from audition to vision and from vision back to audition as they first listen to and then read the selfsame words with the selfsame meaning should lead us to look for just such substitutive functions as the eye performs when one literally sees the softness, coldness or heaviness of objects. We include, then, among the mixed incorporations only those integrated groups of sensational quality to which sensimaginal supplements have actually been added. Where the transferred meaning is carried directly by the primary qualities, without these supplements, the incorporation is closely allied to the primary sort.

Organization of the Secondary Incorporations among Themselves

We saw in the last chapter that synthesis does not stop with the single primary incorporation; with such groupings as underlie the apprehension of a spatial object, of a constant chord, or of a melody. These are only the simplest organized units; whereas our perception of events and of our bodily states and conditions rests upon larger and longer structural groups which flow on from minute to minute and, at times, with scarcely an interruption—as in hunting, sightseeing or climbing—for hours together. Now the same kind of prolonged temporal ligation of the smaller *sensimaginal*

groups also takes place. It takes place, of course, without the direct guidance of stimulus and without the immediate employment of the receptor devices of the body.

The first case is *secondary coalescence*. It reproduces, with exactly the same type of integration, the coalescent form which we found in the tissues and configurations of the primary qualities. Just as the single primary incorporations unite at a given time into a larger grouping, *e.g.*, in our perceptions of movement and of harmonic sequences in music, so do like sensimages stand conjoined in these higher and larger configurations. We remember or imagine these same events and these same objects and by the same experiential means—only substituting sensimaginal for sensational materials.

The next case is the *secondary constellation*. It reflects, in sensimaginal terms, an entire perceptual situation, now converted to a memory or some other "ideational" form of apprehension. As I recall yesterday's visit to the druggist, the "revived" meaning is carried by visual, auditory, somæsthetic and (possibly) olfactory sensimages. Not all the original sensory stuff is now represented; but a good deal of it is, and it appears in a characteristic manner. The formation is looser, and it presents notable differences in the clearness and the obscurity of the several parts. But in its integrative character the constellation is of the same type as the "perceptual" mass of yesterday. Just as I looked around upon entering the door, heard the door close, noted the new magazines, and so forth, by virtue of qualities which were in part successive and in part simultaneous, but *all together;* so now the same kind of temporal linkage and of concomitance is displayed in the new formation.

In the third place we have the *secondary train*. We find here the same kind of formation that we discovered in the long perceptual train induced by the hour's ride in the country. Here is an instance. A half hour ago, as I left the

dining room to go to the study, the doorbell rang and I was called to interview the plumber. When the plumber left, a telegram was handed in and I composed a reply before I came to my desk. These events were separate and distinct in so far as they involved different interests and different matters of the day's routine; but they nevertheless formed a connected train of experience. One phase flowed into the next, the second itself into the third, and so on. And not only were the events kaleidoscopically connected as they actually occurred; as I rehearse them now they are again ligated. Of the rehearsal we say, in common phrase, that the act of leaving the dining room is "associated" with the ring of the doorbell, the sound of the bell with the call of the plumber, the plumber with the telegram, and the telegram with the next event. But we must not misunderstand what "association" here implies. So far as the ligation of mental qualities is concerned, we find just what we should have found a half hour ago when these events really happened; save that now the train is carried in imaginal instead of in sensational terms. And on the meaning side we now find a backward, memorial reference instead of a connected series of perceptions. But as for the form or type of organization, the two cases are equivalent. The meanings we must neglect; otherwise we shall fall into the old confusion of the traditional *doctrine of associationism,* where psychologists made the mistake of substituting the association of meaning-trains for the problem of mental organization. The meanings and objects which were strung together were called "ideas," and so illicitly brought into mind. As we have consistently maintained, this sort of an "idea" is no less an object because it appears "in the head" (*i.e.,* without stimulation of the receptors) or because it refers to "ideated" or remembered or absent objects, instead of to objects here and now. The difference in the object is only one of tense and of place.

Thus far we have examined only those higher incorporations under central conditions which show just the same sort of mental ligation as the primary forms presented. But the reader may complain that we have not really covered the whole field; that we have chosen instances where the central conditions simply duplicate the old arrangement of stimulus. What happens, we are bound to ask, where the old connections break down and new formations appear in their stead? Suppose that in the midst of my rehearsal of the petty interruptions from plumber, messenger boy, and so on, the memorial train breaks and I advert to the price of Western Union stock or to the size of my last plumber's account or to some other matter irrelevant to the original train. Does a new type of integration then appear? Or do we still have the old type with new filling? The second supposition is apparently correct; though we lack sufficient observational material to speak with finality. So far as we have the facts in hand, it appears that no new forms of incorporation or of organization are discoverable, except, possibly, in the case of elaboration or hard thinking. And this possible case is so far removed from our present group of problems that we shall do well to leave it until we come to the study of thought itself. But the break in the train does call our attention to an important fact in organization under central government; the fact which has most occupied psychologists in their treatment of "association." To that fact we must now turn. It concerns the *conditions* under which associative formations are completed.

The Conditions of the Associative Re-formation of Secondary Trains

Why *should* my associative train break and thus fail to reproduce the connected series of events which I was rehearsing? The answer to this question—put, of course, in a general form—is supposed to be given in the "laws," as they

are called, of association. Let us examine the import of these laws.

We can imagine an organism so made that it should, after every exposure to the environment, withdraw from immediate contact with surrounding objects and the impinging forces of nature and re-live, in memorial form, the antecedent experience. Then when the memorial echo had run its course—something like Jaensch's "eidetic" or perceptive image—a new experience might be received and the same alternation follow again and again. We can further imagine that memorial rumination upon the just-past event should permanently discharge the organic functions so aroused and thus, so to say, wipe the slate clean for the next experience. But our actual organisms differ, in two important ways, from this imaginary creature. First, they are unable to resist the persistent importunities of the environment; and, secondly, a mere regurgitation of an experience does not rid the central nervous system of lasting effects. It transpires, therefore, that the results of experience are cumulative, and that the ceaseless march of life is constantly stirring up the residues of not one, but many antecedent functions. Just what control and government the central organs shall, at a given moment, exercise upon the organization of experience becomes, therefore, a matter of very great complication. And it speaks highly for the capabilities of the human organism that any order or any sanity should be infused into functional performances so implicated and so complex.

One generalization upon the nature of neural functions which has helped the psychologist to understand the facts of mental organization runs as follows: *a function when once renewed tends to complete itself in the old way.* This statement, or some variant of it, is often referred to as the "primary law of association." [4] The statement is illuminat-

[4] A corollary of the generalization, which undertakes to state the effect of the functional principle upon the mental formations, runs as

ing and it does seem to express a fundamental tendency in bodily performance; though it is doubtful whether it should be raised to the dignity of a natural "law." While the complete renewal of a function does succeed at times (as our instances of secondary incorporation attest), it transpires far more frequently that the exigencies of present experience or the multiplicity of old but nascent functions prevent an uncomplicated completion "in the old way." Thus the "primary law" is constantly masked by other competing conditions which tend also to determine the associative event. A nascent function may be cut off by another which happens to be stronger at the moment, or it may at least be compelled to join with, and be modified by, that other, or age may weaken it, or a counter-running functional tendency may inhibit it. Furthermore, the functional limits of the organism are, at any moment, straitly limited; while, on the other hand, the possibilities of stirring countless residues of old functions are incalculably great. The central nervous system holds at all times, in a manner that is inadequately known, the residues of thousands and thousands of antecedent functions. These residues tend to retain intact the corresponding functions; but such a retention is, at the same time, rendered impossible by the limitations of the organism and by the amalgamation and the mutual inhibition of different residues. You will faintly appreciate these limitations if you seek to memorize a long column of 4-place figures, after ten minutes another column, and a third column after a like interval, or to remember and recite the automobile numbers that you note upon a crowded thoroughfare. You end with a few clear groups of numbers with uncertain temporal placing and with all the ten separate digits coming up with a haze of indefinite meaning upon them.

---

follows: *Mental qualities which have been conditioned by simultaneous and successive stimuli or by their central surrogates tend to recur in their original relations.*

The conditions, then, under which a given associative re-formation may be realized are very many. They have suggested most of the experimental studies of "association" which men have devised. In order to give an idea of the means and methods used in this research, we shall roughly divide the conditions into three gross groups. The first group will comprise those determining conditions present when the original formation is made, when the original neural function is established. These are called the conditions of *impression.* Thus the number of stanzas recited yesterday, the number of repetitions, and the method of repeating them, are all conditions of impression which help to determine the promptness and the completeness of the associative re-formation to-day. The second group will include those conditions which obtain between the time of impression and the time of associative revival. They are the conditions of the *interval.* The most obvious of them is the length of the time elapsed. Associative re-formation is generally more complete after one hour than after a day, a week, or a month. There are left, then, for the third group, the circumstances affecting the association at the time that it finally takes place. These are the conditions of *reproduction.* Among them stand the general organic state, neural trends and the extra-bodily setting.

We shall rapidly survey these three sets of conditions.[5]

1. *Repetition.* First among the conditions of organization at the time of impression stands *repetition.* Every one knows that the fifth or seventh reading of a new stanza of poetry is different from the first; the whole "hangs together" better after many repetitions; it is "all of a piece"; it "runs

[5] Little more than experimental samples will be given in the text. Fuller accounts are to be found in W. B. Pillsbury, *The Fundamentals of Psychology* (1922), pp. 369*ff.*; H. C. Warren, *A History of the Association Psychology* (1921), pp. 213*ff.;* and H. Ebbinghaus, *Grundzüge der Psychologie* (1911), 3rd ed., Vol. I, pp. 649*ff.*

off smoothly" and is more easily repeated. We have, as we say, "committed" it by reading it over and over. These changes under repetition are indicative of associative organization. They signify, on the bodily side, that the sequence of neural events has been gradually knitted together into one functional unit and, on the mental side, that the members have been consolidated. At the end, they stand bound together in a close and fixed relation. Upon this double consolidation depend memory, imagination, action, understanding and thinking. The precise value of the successive repetitions was shown by Ebbinghaus, whose brilliant work on the conditions of associative organization is one of the most notable achievements of experimental psychology. He re-read 16-syllable series of nonsense words time and again. Some series he read 8 times. Then the next day (after 24 hours) he had to spend 1167 seconds in order to say them off without a mistake. But when he repeated other like series 16 times instead of 8, he had to spend only 1078 seconds the next day. The whole set is shown as follows:

Number of antecedent repetitions	Time (seconds) spent in learning after 24 hours	Time saved by previous repetitions	
		Total	Each repetition
0	1270	...	...
8	1167	103	12.9
16	1078	192	12.0
24	975	295	12.3
32	863	407	12.7
42	697	573	13.6
53	585	685	12.9
64	454	816	12.8

The results suggest two facts of great interest. The first is that each repetition on the preceding day effected approximately the same amount of saving (see the last column).

The second is that, although about 32 repetitions were enough for a perfect recital (to "commit to memory"), additional repetitions—up to 64—effected as much saving of time on the following day as the first 32 had. The consolidation, then, under repetition is gradual—at least beyond eight repetitions—and it continues, as is shown in the sequel, far beyond the point where the series can be immediately reproduced without a mistake.

Unfortunately we have no inspective reports from Ebbinghaus; so we do not know what happened directly to the sensational and sensimaginal factors which enter into each presentation. Subsequent studies, however, have made it evident that notable changes in the clearness and in the degree of conjunction of the members give notice of a gradual consolidation.

In the case of "sense" material, the mental changes under many repetitions are still more striking. As meaning grows and retention becomes fixed, we might expect a gradual enrichment on the side of experience. Exactly the opposite occurs. Beyond the first few readings, when we are, as we say, becoming familiar with the intent of the author, further repetition means progressive impoverishment; less clear qualities more compactly arranged, but greater and greater facility on the side of the central nervous system. Besides the visual processes directly aroused by the first perusal of the page, various accessory means are at first invoked to supplement the meaning; half suppressed kinæsthesis from the throat and from mimetic gestures as well as imaginal materials of the visual and auditory sorts. Later, these accessory means also tend to disappear or to grow obscure, further depleting mind but enriching significance and enlarging "acquisition."

With respect to the relations which obtain between repetition and *length of series,* Ebbinghaus made the following quantitative determination. The table below shows the num-

ber of repetitions necessary to repeat nonsense syllables correctly and without aid, working for 15-30 minutes each time.

Syllables in series	Number of necessary repetitions	Number of repetitions for each syllable above 7
7 + 0 = 7	1 + 0 = 1	0.0
7 + 5 = 12	1 + 16 = 17	16 ÷ 5 = 3.2
7 + 9 = 16	1 + 29 = 30	29 ÷ 9 = 3.2
7 + 17 = 24	1 + 43 = 44	43 ÷ 17 = 2.5
7 + 29 = 36	1 + 54 = 55	54 ÷ 29 = 1.9

This result means that, under these conditions, so soon as we pass the limits of organization for one impression (here 7 syllables) the difficulties are enormously increased. The addition of only 5 more syllables (12 altogether) requires 16 more repetitions, and the next 4 syllables (16 altogether) necessitate 13 more repetitions (29 — 16). Comparing the shortest (7) and the longest (36) series, it appears that when we multiply the length about 5-fold (7 × 5) we multiply the necessary repetitions 55-fold. Still more instructive is the result that once the limit of immediate organization is reached (7 syllables) every new syllable is expensive. It costs at first (on the average) 3.2 repetitions for each additional syllable, the cost slowly declining to 1.9 repetitions at the end. There seems, then, to be a natural limit for "easy" organization beyond which new conditions obtain. With *sense* words of one syllable the limit for a single impression is 8-9, and with number-digits 10-12. The limit is somewhat higher with adults than with children (Ebbinghaus).

It must be noted, further, that so soon as the limit for immediate organization is past, most of the original acquisition is lost. Where a whole series of 7 syllables is retained after one impression, it is not uncommon that only two members (as the first and last) are retained from one

repetition of a 12-syllable series. Even "lightning calculators" seem (apart from their mnemotechnical tricks) to be subject to the same limitations. Diamandi, who was investigated by Binet and Henri, could give back 10 numbers after observing them for 17 seconds, but 20 like numbers required 135 seconds, and 200 numbers no less than 1¼ hours.

Again, it has been found that the extent of the organization of nonsense material is dependent upon the way in which the successive impressions are grouped. It appears that the more the repetitions are broken up into small sub-groups, with time-intervals between, the stronger the associative bonds. For example, Ebbinghaus learned (on the average) a 12-syllable series by 17 consecutive repetitions each. Then he read it through 51 times more—68 repetitions in all. Other and similar series he simply read through until he could repeat them without aid (about 17 times). These he read again, 24 hours later, 12 times, or until he could repeat them, then again after another 24 hours (about 9 times). Thus he had repeated the first lot 68 times; the second *distributed* lot only 38 times (17 + 12 + 9). Yet he found that, after he had left each lot for another day without repeating them, the second lot was better remembered than the first.

A still clearer exemplification of the advantage of distribution (with intervals of time between repetitions) was that of Jost, who also employed 12-syllable series. These he repeated 24 times. Some series he repeated 4 times a day for 6 days. Some series 8 times a day for 3 days, and some 2 times a day for 12 days. The more he distributed, the stronger the associative bonds. The conclusions reached by Jost were as follows:

2 repetitions a day for 12 days gave strongest bonds
4 repetitions a day for 6 days gave less strong bonds
8 repetitions a day for 3 days gave least strong bonds

This advantage of distribution—carried as far as to one repetition every second or third day—has been subsequently verified by many other experiments. The explanation is not clear. The possibility of fatigue from long continued reading of the series was ruled out by the conditions of Jost's experiments. Jost himself thinks that the neural change under impression "sets" or "hardens" for some time if left undisturbed by subsequent functions; but this explanation is doubtful. Possibly the advantage of learning bit by bit with intervals is connected with the small unit-capacity for organization which we observed a moment ago. It may also be connected with the advantages accruing to first and last members in a series—the outer "rim" of organization, so to say. In many small functional units, as in distributed impressions, there is more "rim" and less "middle" than in the large single impressions.

The advantage to the small unit seems also to be obtained by *rhythmizing*. In melody rhythm forms a natural unit, the measure; and the measures are integrated, as we have seen, into larger wholes, the phrase and sentence. In a similar way rhythm has a consolidating effect upon series of nonsense syllables. Müller and Schumann completely acquired 12-syllable series in trochaic rhythm, *i.e.*, /–́ v /–́ v /. Subsequently they made up out of these same syllables new series, some of which preserved the old rhythmical units and stresses and others of which destroyed them. Where the rhythm was preserved, a considerable saving in time for relearning was realized. A similar advantage from stressing the rhythm of verse and metrical prose is generally recognized in the common school task of "committing to memory" in a singsong way.

One of the primary conditions of associative formation is *attention* during impression. Here attention is not to be understood as a power or faculty which explains retention and recall. By making it one of the conditions of organiza-

tion we only mean that the original close organization of clear processes affects the associative integration of a later time or time of "reproduction." Some psychologists have gone so far as to maintain that obscure processes (processes "out of attention") are not subsequently recalled. But the fact that we constantly include in our memories such details as the place on the page, the color of clothes, and other matters not noted in perception, stands against an extreme statement. We can say, however, that clearness, intimate segregation of processes, and the forward-running determination, all of which are aspects of sustained attention, are, when taken all together, an important condition of associative integrity.

Another means of consolidation is through meaning. Ebbinghaus found that he could memorize a translation of the *Æneid* 9 to 10 times as rapidly as he could nonsense syllables. Nowhere do we see more plainly than in this kind of difference—a difference which we all recognize—the essential part which meaning plays in the mind-body functions. Consider the difference in the recital of an hour's well assimilated lecture and the same amount of speech delivered in nonsense syllables! In part, the difference no doubt lies in the fact that the material is congruous with old associative tendencies, which are re-exercised and renewed; but in part also it is owing to the new creation of associative tendencies where the parts are made coherent by a common topic. A new poem represents connections never before made; nevertheless it is much more closely consolidated through its meaning than is the "senseless" material.

Of course we do not really obliterate meaning by the use of "nonsense" material. We get rid only of the symbolical *verbal* meanings. The syllable *GEZ* is as much a meaning as a box or a tree is. It is "that collection of letters there on the page"; or it is "that syllable which has just appeared, been exposed, and which I am to attend to!" It is an object-

known as much as a "real" word is. We must then carefully distinguish between non-sense and non-meaning.

Although long series require a disproportionately large number of repetitions, as we said a moment ago, there are conditions under which it is economical to acquire fairly large masses as *wholes* rather than *piecemeal*. Thus homogeneous sense material, such as poetry, is more economically acquired by reading straight through, and then again and again, than by learning one line or stanza and then the next and the next. This comparison supposes that we leave no intervals but keep steadily at work, either by the "whole" method or the "piecemeal" method. A part of the advantage from the "whole" method comes from the consolidation through meaning. The whole paragraph or the entire poem is one, and the oneness is represented by the organization of all the associative tendencies set up by the "whole" reading. This fact is illustrated, by way of contrast, in incidental matters such as the place on the page or a chance noise outside. Although these extraneous or adventitious incidents are likely to appear when we try to recite the passage learned, they seem (from unpublished experiments made by the writer) not to improve the recital. They do not enter into the meaning of the passage and so they do not serve as incentives to "revival." Another reason for the advantage of the "whole" method comes from the unnecessary and redundant repetitions of the early lines in part-learning. And still another alleged factor is the "wrong" association of the end of a line with its own beginning, as the single line is repeated over and over. This associative connection has to be broken and another (with the beginning of the next line) set up when the learner comes finally to recite the passage straight through.

Thus the fruits of organization, as they are obtained under all these various conditions of learning, help us to see what organization under the guidance of associative tendencies

itself is, and also to see when it is loose and when close. When we come to study the functional operations of the mind-body we shall see that all of these operations depend in part upon older associative organizations which supply factors, both on the bodily and on the mental side, enabling the organism to perceive, to remember, to act, to understand, and to think.

2. *The Effect of the Interval upon Associative Organization.* The fact just now cited that gaps between periods of impression afford a distinct aid to revival suggests that the passage of time itself, once the associative tendencies have been formed, is important for mental organization. Psychologists who contend for "perseveration" think that the interval has a positive effect. They speak of a "hardening" time and of a "set" which occurs after the perceptual and comprehending functions have run their course. But the alleged fact of perseveration, *i.e.*, of a neural change succeeding the impression which actually strengthens the central residues of function and which may lead to "revival," is itself doubtful. Even if it were shown to exist, it might be expected to affect mental organization only by way of preserving the bonds between the imaginal factors in the secondary incorporations or within the associative coalitions, constellations and trains. The striking and obvious effect of time upon associative organization is the negative effect. Total groups crumble and dissolve. Associative bonds weaken and decay. Old associative tendencies once distinct coalesce and fall. One experimental means of determining the effect of time is the employment of graduated intervals with like impressions. Ebbinghaus, again, has suggested a suitable method. After perfecting the associative bonds between the neural processes which carry the nonsense series (13-syllable) he allowed intervals from 20 minutes to 31 days to elapse and then noted the saving in time necessary to relearn.

Interval		*Per cent Forgotten*
Hours	1/3	42
	1	56
	8¾	64
Days	1	66
	2	72
	6	75
	31	79

Obliviscence is here seen to be at first rapid and then slower and slower. It has been measured, in the table, by the number of repetitions necessary to free recital. Thus at the end of the first hour more than half was lost; but after six days ($6 \times 24 = 144$ hours) only three-fourths. More than half as much goes in the first 20 minutes after the material was committed (42 per cent) as goes in an entire month (79 per cent).

We cannot say that this "loss" in memory represents only the loosening of associative bonds. It also represents some neural change, progressive in time, which is at first rapid and then slower and slower. The effect of this change upon relearning the same material appears as a saving in time and in repetitions. Where sense material is repeated, the rate of loss seems to be slower. A whole day after learning stanzas of Byron's *Don Juan,* for example, Ebbinghaus had lost only one half, as against 66 per cent of the nonsense material.

Another striking effect of the time-interval is the early loss of the "secondary" associations, especially of those between distant syllables in the series. Müller and Pilzecker examined these remote connections after the interval by giving to the observer a single word from a preceding series and instructing him to name the next following. After the short intervals (*e.g.,* 5 minutes) the observers often gave by

mistake a distant "secondary" syllable; but after 24 hours the secondary associations almost wholly vanished. The remote connections, then, seem to be both weaker and less durable. We cannot be sure that they fall out so readily, however, where "sense" creates a complicated set of connections, as in our common speech and reading or where perceptual objects and events fall within the same context.

Finally, the interval may supply materials which either (a) retroact upon the preceding materials, suppressing them (retroactive inhibition) or (b) fuse with them, causing confusion or reorganization. An experimental demonstration of the first, the inhibitory, effect was devised by Müller and Pilzecker, who introduced into the interval various tasks and found that when these tasks were set near the beginning of the interval they "inhibited" the connections previously established. It looks as if the neural processes which are released under impression reverberated or tailed-off for some time and that during this subsequent time they were peculiarly subject to damage by new employment of the brain. This ringing-off may be all there is to the hardening time or "set," and it may account for the rapid loss of memory during the first minutes of the interval. The confusions from the filling of the interval (b) are illustrated by the tendency to hale old acquaintances not recently met by slightly inaccurate names taken from later experiences. Thus "Langworth" may become "Woodworth" or "Langley" by an interpolation and confusion from the memorial interval.

Under our first set of conditions of associative organization—the conditions of impression—we observed that repetition tends to reduce, obscure and eliminate, as well as to consolidate, the mental factors. Now we notice also that the lapse of time tends to affect these factors; but that in this case intentional reproduction is rendered imperfect. Although mind here suffers the same kind of eclipse as it does under frequent repetition, the total organic result is

obviously different. Under repetition the bodily residues of function are somehow made cumulative and the *limits* for memory and understanding are extended; but with the passage of time the mental loss is symptomatic of a general functional decline. Where we say that we "commit to memory," by repeating over and over, we should better say that we "commit to the body." The fact that repetition and the memorial interval alike impoverish mind but lead to opposite functional effects illustrates in a striking way the want of parallelism, between experience, on the one side, and the total functional capabilities of the organism, on the other. What is primarily required of mind in matters of functional limit is *meaning*—far more than raw quality, and more even than the organization of qualities.

3. *Conditions Present During Revival.* If we advance from the interval, during which the associative connections persist only on the bodily side, to the moment when they again become psychosomatic events, we shall see that the constellations and trains previously provided for are also dependent upon the sum total of present conditions within and without the organism. Those conditions which immediately induce the new formations are spoken of as the incentives to association. They may be roughly divided into three general classes; stimulus, general somatic state, and neural trends.

The mixed incorporation illustrates one way in which old residues of function within the brain conspire with present stimulus to produce a mental complex. Sensation and sens-image unite in the closest union. But this is not the only way in which stimulus is an incentive to associative formation. In fact, only when some strong functional trend within the central nervous system is in course is the brain free (and then only relatively free) from outside hints, supplements and diversions. These trends most frequently appear in thought, memory and imagination, and sometimes in the

function of comprehension where a topic is supplied and sustained by way of ideas.[6]

The excitation of receptor organs goes further, then, as an incentive to associative formations, than the mixed incorporation. It often touches off a memorial or imaginative constellation or train, as when an object reminds us of a past experience or incites us to such imaginative constructions as the seeing of monstrous figures in the clouds and the fire and as the apprehension of the world's far end at sunset. Once touched off by stimulus, however, the constellation or train may run its independent course under central guidance.

The general somatic state is the second kind of incentive. Presently we shall see that moods, which are carried by the general temper of the organism, not only facilitate individual associative tendencies but also sustain whole neural trends which make our associative topics gloomy, anxious, joyous or irritable—that is to say, congruous with the prevailing mood. A simple posture or bodily set, where no mood is involved, may similarly induce associative formations. I oppose my finger tips, as if grasping an object, and the meaning of a crystal sphere with clairvoyant implications appears. I turn up my palm and recall a beggar on the street. I bend my back and so enter into an imaginary race. It is likely that many of our "free" ideas arise under such unobserved incentives as these.

Most considered by psychologists have been the *central* incentives to associative organization. This preference arises

---

[6] *Cf.* Stevenson Smith and E. R. Guthrie, *General Psychology in Terms of Behavior* (1921), p. 202. "Some sensory cue seems essential to call out a delayed response once the original stimulus has ceased to act." The behaviorists, who like to regard every activity of the organism as a response, seek diligently in all cases for the stimulus. Action is naturally their favorite type of function. Even there they stand in danger of supplanting central antecedents by outside incidents translated into terms of stimulus.

from the tradition of the "laws" of association which have been turned to account by the epistemologist to explain the origin of knowledge. The most impressive of the generalizations or "laws" is the law of contiguity which states that "mental processes" are accompanied or followed by other "processes" which have previously existed with them. As stated in terms of mind, the law is not very illuminating. The reasons are two. It is meaning rather than "process" which disappears and reappears (as in memory). If it were the mental qualities which disappeared and reappeared, we should have to observe that, in the course of years, every one of them appears many times with virtually every other one, so that this law of redintegration would not tell us why, in a particular case, one organization rather than a thousand others should be realized. The generalization becomes more significant when we translate it into neural terms. Although we know but little of the functions of the brain, we do have plenty of evidence that a total neural function leaves behind it a total disposition or trend which tends—as we have observed—to complete itself in the old way once it is renewed. To be sure, time, conflict, and fusion are constantly setting a term to this complete renewal; but the tendency toward it is, apparently, what we discover in our associative and determining tendencies and in our topical and habituational trends. By controlling one or another of the numerous conditions (repetitions, recency, extent of the material learned, method of impression, intent to remember, etc.) and by keeping all the others constant, we are able by our experimental procedures to exemplify and to weight these individual incentives to organization.

The methods, which have supplied us with nearly all of the factual material which we possess, are of two types. The one seeks to actualize existing associative tendencies. It interrogates the organism in order to discover what associative formations are ready at hand. It may be called the "study

of established associative connections." The other establishes its own associative tendencies in order that it may subsequently compare the "impression" with the "reproduction." The most familiar form of the first type of method is that of "paired associates." A word is presented with the instruction to "respond" with some other (the first available) word. Thus the word "smoke" may be called out and followed (on the part of the "associating" subject) by the word "lamp" or "pipe" or "fire." The instructions take two forms, the unlimited (where any word whatsoever may be given in response) and the limited (where the response must be a noun, or a verb, a word of one syllable or some word suggestive of "pleasure" or of "work"). Since the method traffics in verbal symbols, it throws but little light upon the mental factors or upon organization. It is, to be sure, biographically useful, for it reveals certain historical details of the organism.[7] And it has also been used as an aid to linguistic study. It has been directed to the difference in the verbal responses of children and adults, of the normal and the abnormal, to the study of concealed knowledge, and to the origin of pathological states. The pathologists have employed it as a "diagnostic test" to discover the nature of disorders and important incidents in personal history. When it is thus used, it is one of the resources of the psychoanalyst.

The alternative method attempts to form new associative tendencies and then to watch their results. Ebbinghaus virtually created the method by his quantitative use of "nonsense syllables." Because it is able to prescribe and to control the conditions of "impression," of "interval," and of "re-

---

[7] Not by any means is the verbal response a complete report of the associative complex. Mayer and Orth found that in 2/3 to 9/10 of paired associates intermediate material intervened between the word called and the response (*Zeitschrift für Psychologie* (1901), Vol. XXVI, pp. 4-5); and these investigators did not attain to anything like a complete inspective account in terms of quality.

production," the method has distinct scientific advantages; for in spite of its refinements, the first method, which presupposes the long and tangled history of the individual, is a method of divination. Its chief value lies in the clinic and in the practical "test."

CHAPTER VI

TOTAL ORGANIZATION UNDER EXTERNAL AND CENTRAL CONDITIONS: ATTENTIONAL CLEARNESS

Attention in and out of Psychology

Outside of our psychological studies we know "attention" chiefly as an ally or as a duty; an ally when it enables us to dispatch work, to outdo a rival in sport, or to keep the run of a conversation; a duty when preceptor or conscience whips our flagging interest in an unconquered task. By "paying attention" to this or that matter, as the common phrase goes, we accomplish in the face of difficulties and of competition. Attention easily comes, then, to be regarded as a selecting and intensifying force or power which saves time and waste and augments production and accomplishment.[1] But here we seek another aspect of attention, its organizing aspect. The uses of attention considered as an ally or a resource may be referred to the champion of faculties and powers, and the duty of attentiveness may be intrusted to the moralist and the pedagogue.

Already we have learned that, so far as the individual mental quality is concerned, attention comes in simply as a quantitative attribute, as clearness. A given tone or odor or pressure is noted as more or less clear, more or less obscure, just as it is strong or weak; *i.e.*, near to, or remote

[1] "Wherever there is an effect that cannot be explained by sensation and association, there attention appears upon the stage. In more complex systems attention is the makeshift, or the scapegoat, if you will, which always interferes with the working out of these other principles." K. Koffka, *Psychological Bulletin* (1922), Vol. XIX, p. 535.

from, the zero-point of intensity. But attention has also to be considered with the integrated complexes. Our incorporations, constellations and associative trains bear the most intimate relation to attention. The clearer qualities are also the more highly organized. To be "in attention" only means —so far as mind itself is concerned—to be clear and organized. It is as if experience were constantly and consistently illuminated in certain spots by a light of high power. Of course, the light is only a figure; for mind is not a dim misty object in space and it is not thrown into relief by some outside illuminant. The fact is rather that always certain members are clear and closely organized and others relatively dim and loosely organized. The former taken altogether we call the "foreground" and the latter the "background." That this characteristic organization of experience at large is of fundamental importance in life is attested by the fact that its disturbance or disruption leads to a great number of the "mental" disorders.

Clearness-Degrees

The first concrete problem which attention suggests to mental constitution is the number of clearness-degrees present at any single time and the relation of the various degrees to the integral character of experience. All our figurative expressions about attention—as a focus, as a foreground, as a luminous spot, as a central area set off from a dark margin —suggest that it always presents a single high clearness set against a background of great obscurity. Observation sustains the view that there are one or more groups of high clearness, and many accompanying obscure processes; that relief and depression—to change the figure—exist together. But close scrutiny nevertheless leads us to qualify this gross distinction, and to qualify it in two directions. First, the clear qualities show small differences of degree among themselves and so do the half-organized, obscure processes. If

we establish a scale, say, of nine degrees of clearness, then at a given moment of inspection the degrees 2 and 3 or 1, 2, and 3 may be observed among the clearer group and the degrees 7, 8, and 9 among the obscure. Secondly, the clearness-difference between the groups may so shift as that at another moment the trained observer may discover the degrees 2, 3, 4 (or 1, 3, 4) and 6, 7, 8 (or 6, 8, 9). There appear also to be limiting cases where the degrees are so distributed (*e.g.*, 1, 3, 5 and 6, 7, 8, 9) that it is no longer profitable to speak of two "levels" of attention, or more grossly of attention as set off discretely from inattention. To establish the exact relations between the clear and the obscure members requires highly specialized training which relatively few psychologists have acquired. If you were yourselves to try to observe in terms of clearness you would inevitably fall into the mistake of describing the clearness or unclearness of the objects of perception, memory, and thought, or the exactness and exhaustiveness of your knowledge of these objects. You would probably say, *e.g.*, that the notes of the first violin in the orchestra were clear and that the unobtrusive hiss of the radiator or the pressure of the pen in your fingers was obscure. The one you would be judging in terms of its consequence, dignity and impressiveness in the whole performance, the other in terms of its weakness, casualness and lack of importance. But the violin note might (although strong and impressive) be carried by obscure tonal sensations and the hiss or pressure might, on the other hand, be carried by qualities of the degree 1 or 2. The clearness of knowledge or of the object-known is quite a different matter from the clearness of the underlying mental processes. The first is known to the psychologist as "cognitive" clearness, the second as "processual" clearness or attensity.

In spite of this factual difference between qualities and the meaning which attaches to the integrated group, it must be observed that clear, compact and closely organized processes

make the most suitable vehicles for certain kinds of knowledge. When we wish critically to observe an object, we pass the eyes over it or explore it with the hand or recall in detail our previous experiences with it or imagine the changes which it may have undergone in remote times. Thus we encourage the arousal of a large number of clear and well organized qualities which represent varied aspects of the object, and so lead to accurate and intimate information about it. We may say quite generally that low-level minds, processes of 6-9 clearness-degrees, would hardly have given rise to the coherent knowledge of the world—imperfect though it is—that men have come to possess.

Attention and Organization

We now know from our study of incorporations that stimulus and receptor give rise to natural and, so to say, inevitable forms of mental integration. The nodal vibrations of the tense wire or of the column of air in the organ pipe lead to tones of definitely related pitches which make up—as they stand closely fused—the musical note. The pattern on the retinal image throws together in determinate ways the light and color qualities, the tick-tocking of the pendulum integrates the rhythm, and so on. Moreover, this welding and fusing and tying together under organic and external conditions usually involves an emphasis or exaggeration over others of certain constituent members. The fundamental in the note is usually the most prominent member, the reds are somehow insistent, the flat and slightly dragging "tock" gets a large and important place in the rhythmic complex. That is to say, certain mental qualities stand, in their own right and apparently through some virtue of their exciting conditions, at a relatively high degree of clearness. Whence this advantage comes we may later inquire when we trace the history of mind. At present we shall just accept it as a fact.

When we turn from the individual incorporations to the chains and trains of perception, we find likewise that the temporal leading on from one thing to another brings a kind of pre-determination of the clear and the obscure parts. Those parts which sustain the topic, as the driver's intent regard of his engine and of the road, the prolonged inspection of a new coat, and the intent observation of a passing parade, attain to and preserve a degree of clearness which is not, as a rule, reached by more incidental processes. On the other hand, the pressures from the hand upon the steering-wheel, the fleeting colors from the corner of the eye, the hum of near-by voices, the tramping sound of many feet, are apt to set up dark and obscure qualities which provide a kind of subdued accompaniment to the main theme. Also, in the second place, clearness in the antecedent is likely to lead on to clearness in the consequent. The qualities of high clearness are somehow bound together in the sequence, chiefly sustained at their level by conditions of stimulus.

These conditions of clearness which we have observed among the primary colligations are also carried over to a certain extent in the secondary and mixed forms. The general types of incorporation are, as we have seen, the same, and the sameness derives, in part, from the preservation of like clearness degrees as the perceptual complexes pass over into imaginal. Indeed, this preservation largely accounts for the fact that our memorial and imaginational references constantly lead us back to the objects and the occurrences of sense.

The long associative trains themselves, to which we were finally led in our survey of the ultimate modes of integration, maintain, in part, the attentional emphases and neglects which we may trace back to an original perceptual series. A final animadversion to the commonplace distractions of the plumber and the messenger boy reveals the similarity of clearness and obscurity, of stress and slur in the memorial

train, on the one hand, and the original sensational patterns, on the other.

So far we may go in attention, keeping within sight of peripheral and external conditions which govern clearness and obscurity. But beyond this point we have to consider conditions of another order. As the corporate bonds decay, as the configurations fade and recombine, and as the topics of thought are fed from various and widely separated associative sources, we see the attentive amalgamation of new syntheses and a consequent re-ordering of the clearness values.[2] We must not overlook the aspect which our topic wears when "attention to" an object is specifically provided for by some form of self-instruction. Here is an instance. I pluck the stretched string of the tonometer or the harp after instructing myself to "hear out" the second overtone. If I am trained in the exercise, a pitch standing at a twelfth from the fundamental presently "emerges," *i.e.*, it rises in clearness while the fundamental retires. The conditions of stimulus remain as before; but the central conditions are so shifted that the second overtone is now clear where before it was obscure. Such phrases as "turning the attention toward," "fixing the attention upon" and "bringing the topic under attention" are attractive figures of speech which seem to fit these cases. They must be avoided, however, unless we wish to substitute a hypothetical faculty of attention for the descriptive facts of mind and of the nervous system. The main difference is that, in these latter instances, which

---

[2] As I search for examples to illustrate the fact I revert to the beautiful and straightforward account of "association" in the late Hermann Ebbinghaus's *Grundzüge*; I recall the erudite and logical discussions of Stout; I light upon Titchener's courageous, if labored, attempt in the *Beginner's Psychology* to emancipate himself in his thinking from the bonds of associationism. Here my topic "association" held, as we say, "under attention" is enriched from a variety of sources. New integrations are formed and new clearness values are established.

are not confined to "ready-made" integrations of sense, the distribution and the sequence of the clear processes are determined by functional trends in the central nervous system, trends released by the self-instruction.

To resume, then, attention appears in the individual process only as clearness-degree; and in the mental complex and in the total mind as a close or loose organization of clear and obscure members integrated into incorporations, constellations and trains under the singular or conjoint influence of stimulus, receptor and central trend.[3]

[3] Wherever attention has retained its magical properties as a director, selector, and guide to the organism it has swept together a mass of material of doubtful character and of uncertain classification. Within this mass we may distinguish a variety of topics; *e. g.*, (1) the "range" of attention, a topic which properly belongs in a discussion of the limits of psychosomatic function (Chap. xvii), (2) the doctrine of a "voluntary" attention, which was designed after the fashion of the "willing" faculty, (3) the separation of "primary" and "secondary" stages or grades, which calls for a genetic treatment of the psychological organism (Chap. xix) and (4) the "lag" or "accommodation" of attention, a topic falling under the study of the antecedents of the various functional operations (Chap. xvi).

CHAPTER VII

ORGANIZATION WITH SUCCESSIVE MODIFICATIONS: HABITUATION

The Nature of Habit

The topic of habit is poor in descriptive fact and rich in speculation. The commonest meaning of the term is obvious to every one. When men are said to be "creatures of habit" or "victims of habit" or "bundles of habit" the implication is that their actions, thoughts and beliefs have been made rigid, stereotyped and inevitable by frequent repetition. Repetition, instead of leading to wear and disintegration—as in the use of tools and machinery—is here observed to lead to promptness, invariability, ease and a certain conclusion.

In our own present concern we shall be interested in habit and habituation only as they affect the integral constitution of mind. The relation itself stands clear. The habituated mind, the mental flow under habitual performance, is clearly different from the state of concentrated inquiry into a new subject or the performance of a novel and untried act. But what, precisely, is the difference?

Not infrequently habit is regarded as a sort of faculty, a gift to the organism, which enables it to profit by the use of gradual acquisition. As distinguished from "instinct" it is an individual acquisition instead of a racial endowment. Both terms are made illegitimately to represent powers—"instinct" a power hereditarily derived, "habit" a power or potentiality accumulated through a number of like experiences of the individual. The terms are made scarcely less

misleading and illicit through their dependence upon the loose speculations of biology than are such words as "will" and "thought," when these latter are used to denote the mere capacities and powers of an enduring soul. Both sets of terms call for empirical description.

Because "habit" is an abstract and poorly defined concept, we shall do well to substitute wherever we can the word "habituation" and to ask quite concretely, "what are the effects upon mind of continued repetition?" The *bodily* resultants are conspicuous. Every one knows that the thoroughly habituated use of table silver, of the tennis racket, of the hammer and the pen is a skillful, facile use. The performance "runs itself through" deftly, unhaltingly, easily and effectively. Unnecessary movements are wanting; the energy at hand is economically expended and the act marches straight toward its goal. What happens, in the meantime, to experience and what is the end-result for organization?

It is sometimes assumed in the discussion of habit that the main thing is the sheer channeling of the mind and body. We speak of the "grooves" of habit; and we declare that "practice makes perfect." In his chapter on "Habit" James implies this sort of channeling effect where he approves Carpenter's declaration that the "nervous system grows to the modes in which it has been exercised." Now it is true, as we have seen, that the mere running through of a bodily function, time after time, strengthens the function and disposes it more strongly to an independent and fixed course. Evidence of this result appears in the "strengthening" of associations by repetition. But of greater importance in habituation is the series of modifications undergone in course. Repetition offers many successive occasions for such changes. The young child learning to write under the guidance of an instructor has occasion daily to eliminate, to alter and to augment his performance. Useless and distracting movements of tongue, face and legs are dropped; the pen is shifted

to new positions and it is dipped just before it dries; the hand becomes relaxed; the characteristic heights of the small and the large letters are noted; ways of connecting successive letters are acquired, and so on to a half-hundred or more modifications which tend toward rapid, precise and legible execution. Research upon the stages of acquisition in telegraphy and typing has shown in detail the many shifts both mental and physiological which mark its progress. Investi-

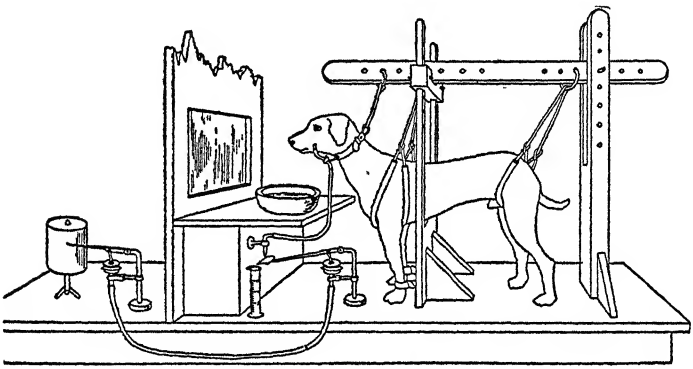


FIG. 26. PAWLOW'S DOG
From R. M. Yerkes and S. Morgulis, "The Method of Pawlow in Animal Psychology," *Psychological Bulletin*, 1909.

gations of this kind have made it evident that characteristic changes occur under habituation both as regards the mental qualities and as regards their integration.

What is the character of these changes and upon what do they rest? We found under association a bodily aptitude toward the completion of old functions when once the old functions were renewed. Now we must invoke another principle of neural operation. It is this. Under certain conditions neural functions tend during their course to incorporate new factors which appear upon renewal. The principle is well illustrated by what is known as the "conditioned reflex." It is well known that the presence of cer-

tain foods within the mouth elicits salivary reflexes and leads to the secretion of digestive juices. It has been discovered that the same reflexes may be elicited by a given sound (as from the ringing of a bell) provided the bell is repeatedly rung when the food is placed upon the tongue. The sound now becomes the stimulus to the secretory reflex which is then said to be "conditioned," and it may replace or act along with the original food-stimulus. Thus a relatively simple neural function is modified by a new factor which is not only incorporated within it, but which may, upon occasion, serve as the first and initiating member of an entire functional operation. Many of the properties of the conditioned reflex have been experimentally discovered by physiologists and others.[1] The fact of "conditioning" or of substituting an "artificial" for a "normal" or "primary" stimulus interests us here because it helps us to understand the bodily aspects of many of the experienced modifications which the total organism undergoes during repetition. We are apt to forget, because we are intent upon the repetitive side of habituation, that the circumstances under which we repeat our performances seldom remain exactly the same. It follows, therefore, that as experience is gradually organized it is also gradually molded and modified. The stroke in tennis comes in time to be governed not by the ball immediately before the racket, but more remotely by the posture and swing of the opponent; the swift movements of stenography, not in imitation of a figure upon the blackboard, but more remotely again by the articulated speech of a lecturer.

In the second place, habituation progresses by ligation. Here once more we find an ally in the nervous system. Successive functions which are at first independent tend under repetition to merge into a train. This invokes one of the

[1] J. B. Watson, *Psychology from the Standpoint of a Behaviorist* (1919), pp. 28*ff.*; K. Dunlap, *The Elements of Scientific Psychology* (1922), pp. 210*ff.*

most important principles which underlie the gradual organization of experience. A large part of the developmental process in the individual's career rests upon the fact that repetition establishes new ligations and new trains. The meager store of original neural functions, dependent upon visceral processes, the search for food, and the more or less constant dissipation of energy in random movements, is continually augmented by repetitions. These repetitions introduce new members and bind them together into sustained operations.

But not only is experience organized by the addition of new "conditioned" factors, and by temporal extension. It is also organized by ellipsis. The psychosomatic functions offer many opportunities for short cutting in course. Elimination is as important as addition and extension. Thus, in our instance of the child's early attempts at writing, in learning to dress the body, to use the table silver and to drive the family car, many factors come in time to be dropped out, the organism progressing only from the essential to the essential. Economy of performance is thus secured; an economy which means for experience high organization, compact unities and a rapid and smooth sequence from phase to phase. When we come to consider in order the psychosomatic functions we shall find that every one of them, from perception to emotion and thinking, is immeasurably facilitated by the consolidations, the extensions and the ellipses which experience gradually acquires under habituation.

The Three Forms of Habituation

1. Though we must allow for special forms and circumstances, it appears that, in general, the early repetitions are richest in qualities deriving from stimulus and receptor. The details of the tennis field are scanned, the surroundings are noted in a haphazard fashion. Kinæsthesis is as rich and as varied as the bodily movements are many and variable. The

novice comments upon every play; he exhorts, condemns and praises himself. Emotive coloring is bright and changeable. The activities of the organism bring into existence a large number of sensational processes. As the player acquires proficiency these processes decline both in number and in clearness. The visual field is narrowed, indirect vision and obscure qualities playing a larger and larger part. With this decline usually comes an increase in sensimages. The central processes free themselves in part from the domination of the receptors. Associative complexes arise. Finally, to consider only three general stages in a process which is well nigh continuous, the course of the bodily events is rapid and certain. Adjusting movements are made without imaginal antecedents. Motives disappear. Ideas are few. A small number of relevant processes remain clear. These are welded together in fixed trains, the direction being determined at every instant by the progress of the game. Mental organization is of the hypnoid type, characterized by a vivid and restricted foreground closely organized and an exceedingly obscure background which is itself much more highly organized than in non-habituated experience and which performs quite as important a part in keeping up the game as does the foreground.

2. There is, however, another aspect of habituation which is of great importance to our present study. Accounts of habit commonly assume that the total mind and the total body are directly involved. As a matter of fact, many of our skillful and smooth-running acts involve what we may call the double-faced mind. Habituation facilitates certain psychosomatic performances only that other, non-habituated functions may be carried through at the same time. As I write I compose. A small part of experience is directly concerned with the setting down of characters upon the paper. The habituated part has somehow got itself incorporated into the total performance. Until I stop to consider, the visual

and kinæsthetic factors are obscure processes which are, nevertheless, coherent and internally organized. They represent a closed and integral set of functions which have become under frequent practice thoroughly habituated. They progress easily and smoothly. And yet their course is not predetermined. What I actually set down at any instant depends upon my thinking. Another, non-habituated set of functions supplies and organizes the mental materials which carry the thought-topic. Here enter most of the clear processes and here appears the unfolding topical significance. One part of the whole is the automatic part and the other part is the controlled and directed thinking. There are two fairly distinct trains, the thought-bearing train and the habituated scriptforming train. Where the non-habituated part is wanting, where no topic emerges, we speak of "automatic writing." The writing proceeds as if it were being composed; but the total flow of mental-bodily events is of the habituated kind. This state of automatism, although it appears strange and—as we say—"abnormal," does not essentially differ from those absorbing games and sports which complete habituation carries on through a complicated performance without reflection, without motives and without plans. Every new phase in the progress of the game—as in tennis—calls forth the appropriate coördination of movements. In the game the habituated functions are sustained from the outside by way of stimulus and receptor. In the automatic writing the organized and habituated functions of the central nervous system replace the environment and themselves sustain the manual processes of inscription upon the paper.

3. There is also a third form of habituated performance which involves still another phase of mental organization. It is represented by walking and by such casual occupations as knitting and crocheting. Here the mental stream is usually divided into fairly distinct channels. High motor co-

ordinations are independently sustained under habituation, coördinations which progress while the individual is engaged upon some unrelated matter. These coördinations are guided and sustained by visual, tactual and other processes; but the guidance itself falls within the range of habituation, and it may be neither disturbed nor facilitated by a foreign topic of thought, resolve or imagination, running its independent course. Not only is the organization of mind here divided at every stage; each organized group runs its independent course from moment to moment and from stage to stage. It is temporally bound together in its isolated course. Many feats of the conjurer and of the stage magician display habituations of this "bifurcate" kind.

In fine, the process of gradual habituation brings to mind different groups of sense qualities and sensimages, the contents undergoing change from stage to stage. These processes tend, especially in the later stages, toward consolidation and compactness. Clearness generally declines within the habituated group and the temporal ligation becomes close and firmly established. We must, however, distinguish (1) the totally habituated mind, *central habituation,* from (2) the habituation which is conjoined to, and sustained by, nonhabituated functions, *contributory habituation,* and from (3) the independent or *bifurcate habituation* which brings to experience two conjoined and separately organized trains.

Habit and Instinct

These terms are often used to indicate forms or classes of action; but they really indicate the history of certain executive performances. So far as the actual execution is concerned, it is usually impossible to distinguish an habitual from an instinctive act. Instead, we distinguish them either by a label (*e.g.,* "this is a case of nest-building and nest-building is set down among the instincts") or by reflection upon their history. The most general distinction is between

innately prepared (the instinctive) and acquired (the habitual) performances. It is safe to say that if we were to classify our actions descriptively, *i.e.*, according to the mental and bodily factors actually involved, we should never come upon the distinction. So far as habituation and innate tendency are concerned in the organization of mind, we have already considered them. How they come into the developmental molding of mind we shall discover when we discuss the history of mind and of the psychosomatic functions. The long inventories of instincts which occupy a prominent place in behavioristic treatises are not based upon "modes of operation," as we have considered the actions. They represent instead various attainments of the organism, food-getting, breeding, defense, and the like, connected with the adaptive performances of living and not falling within the boundaries of psychology.

PART III

THE PSYCHOSOMATIC FUNCTIONS

CHAPTER VIII

THE NATURE OF PSYCHOSOMATIC FUNCTION

The Mental and Bodily Contributions to Function

When the subdivisions of psychology were distinguished the contention was made that all our direct and first-hand knowledge of mind is derived from observation; just as all first-hand knowledge of the physical world is derived from observation. Accordingly, we have until now wholly depended upon the reports of inspection, speaking in terms either of component qualities or of organization. Now we come to a different sort of task; the task of functional description.

Mind is intimately concerned in most of the performances or activities of the organism. When we perceive we use our eyes and our ears and our exploring hands to arrive at the knowledge of objects; but just as much are also involved the qualities of sight and sound and the somæsthetic qualities from hand, muscle and tendon. When we purchase a ferry ticket or select our fruit at breakfast we obviously employ our bodily members; but the purchase, the selection, and a thousand and one other acts just as obviously include mental factors which intimately coöperate in performance with the body. So we do not think, imagine, remember and approve with disembodied minds or with senseless bodies; but always with the conjoint agency of both.

We must not therefore lose sight of the fact that anything like a "pure mental function" or a sheer spiritual "faculty" is either a fiction or an abstraction. It is a fiction when it is created, as the "faculty of memory," just to explain the

observed fact that past events and experiences are revived or remembered. It is an abstraction when the mental factors in perception, thinking or action are taken by themselves as if they were the sole factors concerned. So long as we were describing experience itself we were bound to depict it in its own terms, for its members and attributes are ultimately different in kind from the bodily members and attributes; but so soon as we turn to the *performances* in which mental and organic factors unite, we have to acknowledge—if we are willing to be guided by the facts—that the body always contributes its part, even where, as in "reasoning," our common conceptions tempt us to lay the emphasis upon a mental "force" or upon some "rational" faculty. It seems to be the failure to keep distinct these two tasks, the task of mental description and the account of functional performance, that is responsible for much of the confusion within the subject, as well as for the endless contentions between the psychologists of the flesh and the psychologists of the spirit.

We begin our functional sections, then, with the understanding that always in performance the psychologist has to reckon with two sets of factors. He has there to treat of the *psychosomatic* functions. Both factors are involved very much as mechanical contrivance and combustible fuel are involved in the running of the gasoline engine.[1] The hypothesis of purely mental functions we shall not appeal to; and those which are purely somatic we shall leave aside for the physiologist and for certain students of "behavior."

First it is proper to ask what the body contributes to these conjoint agencies, and what mind contributes. Unless we are content to lapse into the ancient distinction between ma-

[1] We disregard in our psychology such organic functions as digestion and circulation, except where these either (1) condition experience or (2) unite functionally with mental factors (as in certain emotions) or (3) are modified in their course as the result of some psychosomatic performance, *e.g.*, the determination to hold the breath or a gastric disturbance resultant upon prolonged anxiety.

terial energy and psychical energy or between two forces or powers, we shall have to come to terms with the two unlike factors which we actually and concretely find to be concerned in our perceptions, memories, emotions, and all the other functional "activities."

Beginning, then, with the bodily side we observe that the physical organism contributes what we may call the *vehicle*. What the vehicle is when we look at an object from the window, or hear an acquaintance call from an adjoining room, or move to press the lighting button, or turn away in anger from an insulting remark, is wholly apparent. The eyes, the ears, the arm and hand, and the general musculature are most obviously involved in these performances; and it requires only a fragmentary knowledge of the nervous system to remind us that neural pathways, brain tracts, latent residues of earlier function and avenues of discharge are also necessary to complete our understanding of the vehicle in perception, memory, action, emotion or thought. In one performance, certain parts of the whole vehicle are most fundamentally called into play, and in another performance other parts, other structures and other functional tendencies. Altogether the bodily vehicle of the psychosomatic functions includes practically the entire physical organism with its racial and individual histories engraved upon and within it.

In the second place, it is obvious that the body supplies *energy*. Along with the general tendency of inanimate nature toward the dissipation and the degradation of energy, runs life with its reservoirs and high levels, converting food into complex substances which are capable of sudden and explosive discharge of energy in the forms of work and heat. Especially the instable nervous system, with its high sensibility, its rapid conduction, and its powerful releases under slight provocation from stimulus, is capitally designed for the sudden employment, both in the form of neural change itself and in muscular work, of the energetic resources of the or-

ganism. Some men speak of a "mental energy" resident in, and expressed by, mind itself; but such a conception of mind is purely hypothetical and wholly unlike the mind, amenable to observation, which we have had under our scrutiny. We shall scarcely, unless we are constrained by our future exposition, have recourse to such a speculative mental or "psychical" energy; for the bodily vehicle appears to be exactly designed to supply the dynamical, or at least the energetic, term in our functional performances. One of the offices of the brain of the higher animals appears to be just to provide enormous stores of material which can, at a moment's notice, be drained of energy at a crisis in emotion, action or thought. A whispered word of startling news, an unexpected tap upon the back in the darkness, or a message flashed from a great distance, is sufficient to release within the brain enough energy to sustain for hours together a violent motor agitation of the entire body. For the present at least, then, we shall regard the bodily structures and activities both as the vehicle and as the source of energetic changes in the functional performances with which we are now to be concerned.

What part now does mind play? If the body furnishes the vehicle (or "mechanism") and the energy for perceiving, acting, reflecting, enjoying, and the like, what is left for mind? Are the mental factors only casual and adventitious accompaniments running parallel to the bodily processes? So the venerable doctrines of "parallelism" and "epiphenomenalism" have asserted. To these doctrines mind was but the froth upon the wave, the shadow following the substance, the echo pointing backward to the sound. Let us forget doctrines and theories and face the facts. First we observe that the psychologist's analysis of a perception, a memory or a bit of thinking always does reveal the presence of the mental factor; and secondly it appears that without this factor no object would be apprehended and no con-

clusion reached. The accomplishments which we note would be inconceivable.

The obvious contribution from the side of mind is the fact of reference or meaning. The visual qualities which arise as I look from my window mean "eucalyptus trees"; the auditory qualities "a chattering squirrel" and "the distant wash of the sea"; the incipient pull of kinæsthesis that "yonder rock on the edge of the cliff is likely to slip to the beach below," and so on with the rest. This sort of "reference-beyond" is never carried by the physical eye or ear or muscle. Meaning, reference, one existence pointing to another, seems always to imply some form of mental existence.

We do, it is true, speak of the meaning of physical objects. We observe, for example, that the red light at the crossing points to, means, suggests danger; that the five o'clock whistle means that the working day is over; a whiff of coffee or of broiling steak in the air that some one is preparing a savory meal. Again, the evolutionary doctrine of organic struggle and survival has contended that the possession of such special and convenient devices as horns or claws or a high resistance to disease means adaptability; that these things are a sign that the *creature* is adapted to its surroundings. So we have come to read a kind of symbolic, evolutionary meaning into form, structure and functional tendency; as if the animal or plant stood not only for its own existence but also for something else which lay beyond.

In both of these ways, then, the way of the signpost and the way of adaptation, the character of reference, of the ability to point to or to mean some other existence or fact, seems to belong to physical objects as well as to mental processes. But in these physical cases the reference is only borrowed. It is the apprehension or the thinking of man that makes it. The danger sign is a symbol or a signal only when some being or other has so divined it by means of one of the psychosomatic functions. Thus mind is, after all, involved here too. Meaning has been injected into objects by the achievement of some organism which has made use of its mental resources as well as of its physical resources and its available energy. Only mental existences, then—that is our point—have the property of referring beyond themselves to other things or facts. Meaning is therefore an unique

contribution which mind makes to the performance and the accomplishments of the organisms. Without it there would be no apprehension of the past, present, and future; no distinction between now and then; no collection of relevant matters out of different contexts—only the unapprehended flow of events.

It is a mistake to suppose that meaning always implies the existence of an object. The diversity of meaning is very great. It includes (when put into verbal terms) "there is a problem to be solved," "a change is coming," "time passes slowly," "is the effort worth while?" "I like the proposal," "I begin to see how it goes," "the strain is exhausting," "springy health and high spirits" and thousands of similar significances which do not fall under the common but erroneous doctrine that the only office which mind fills is either the creation or the reflection of an object.

But is meaning the only contribution which mind makes when conjoined in function with the body? Students of life have often contended that it is not; that mind sustains some essential relation with the very existence of life. This contention appears in those forms of "vitalism" which speak of an "entelechy," "mneme," "élan vital," or "creative mind," and which refuse to limit life to the mere coördination of physical forces within the organism, or the maintenance of metabolism or the physico-chemical interplay of the organism and its surroundings. Only a little less speculative are the theories which find the essence of life in such a vital principle as "desire," "striving," "libido" or "purpose." In all these ways has mind been given a *dynamical* interpretation which is designed to make it a force intimately associated with life. Is such a dynamical interpretation justified in psychology? We shall be helped toward an answer to this difficult question when we have observed that all of these "vital" terms are explanatory, not descriptive. Such a mind as they imply is not amenable to inspection. And since our own inquiry is empirical and our description of

the mind-body and of its operations drawn from our concrete experiences, we cannot admit them into our treatment.

It is not unlikely, however, that so persistent and so intriguing a conception of mind as we find sustained by the "vitalists" contains a modicum of truth. So far as we know its history, mind has been closely bound up with life. Variations in the form, the complexity, and the mode of life are reflected in mind. We no more expect identical minds in the star-fish, the earthworm, the ant, and the mammal than we expect the same disposition of organs and the same developmental history. The mode of life and the character of the organism are, without doubt, related to the processes of mind. Again, it is an observable fact that the total state and functional disposition of the living organism are at certain times mirrored—if we may safely use the term—in the general trend of experience, which thus becomes a kind of indicator of the fluent and shifting states of the total organism. Upon considering the close relation between experience and the nervous system, the most highly integrative of all the bodily systems, we have seen a reason for this indicatory aspect of mind. When we regard "life" as the onward-moving, fluent, and mobile integration and re-balancing of all the metabolic processes, it seems to be natural that its general tenor as well as its vicissitudes should be reflected in the total functions of the central nervous system and therefore in mind.

It is especially in the moods, the cravings, the needs on their way to satisfaction, the posturings and the large emotional dispositions that we read—as we have said—the gauge of the individual life. So far we may safely go with the dynamist and the vitalist. We may also observe that our two-sided functional performances, which we shall have presently to describe and to distinguish, include in their results changes, modifications, and disorders of respiration, circulation, digestion and glandular activity. The discharge of a psychosomatic function may issue as naturally in the re-

straint of the breath or in the increase of adrenal secretion as in the putting forth of the hand or in the solution of a thought-problem in mathematics. Mind thus appears as a conjoint agency; but never, so far as we observe, as an independent cause.

We shall not, then, find it necessary to assume any mental force to illustrate the "power of mind over matter," any dynamical push or thrust in the mind which makes it, apart from the body, an independent governor or law-giver. It does mark the rise and fall of energy, the loss and recovery of equilibrium, the surplusage and defect of metabolic change, high tide and low tide, quickened function and frictional impediment; and it does appear in the unitary and coöperative activities of the psychosome or mind-body.

We come now to those performances or accomplishments of the organism which we call—because they involve both physical and mental factors—the psychosomatic functions. These functions are not to be regarded as the mere addition of experience to the physical body. Neither are they to be regarded, after the manner of the physical sciences, as mechanical operations of the organism which are passively accompanied or shadowed by "parallel" mental phenomena; processes invariably present but adventitious and "epiphenomenal." Perceiving, remembering, planning, thinking and acting are unitary performances which rest upon our two coördinated factors. They are to be regarded as products, not as sums. Perceiving ceases to be perceiving so soon as either factor is removed—just as really as the product "6" ceases to be a product when either the factor "2" or the factor "3" has been removed, or the deflected path of the billiard ball understood so soon as either the cushion or the cue is left out of consideration. When we abstract the mental qualities and regard them descriptively by themselves, we leave the point of view of the psychosomatic functions and return to our inspective study. On the other hand, when we

separate out the bodily factors, the brain and the nerves, the muscles and glands, and consider them as the physiologist or the biologist does, we likewise drop out the psychosomatic functions. It is the same in principle as if we studied the running of the internal-combustion engine as a performance dependent at once upon suitable materials (steel, brass, iron, aluminum), the mechanically fashioned totality and the expansion of gasoline under a sudden rise in temperature. The running, the performance, the functioning, disappears when any one of these essential factors is taken away. There remains the study of materials, of mechanical principles and of the properties of gas—all antecedent studies necessary to the thorough understanding of the operation of the machine, but all different from the operation itself. So, too, the physiologist may factor the processes of gastric digestion into stomach and accessory structures, solvents and the ingested food, all factors necessarily involved, but no one of them equivalent to the total train of operations which taken-all-together make up digestion.

The Method for the Study of the Functions

It is important to repeat that, in passing to the study of function or operation, we enter a subdivision of psychology quite distinct from those parts already explored. It is called the "functional" division because it is the study of the way-in-which, of the going-on-to-accomplishment. Our problem changes. No longer do we study mind-for-its-own-sake. Rather do we study it as one aspect or factor in a conjoint agency. No longer do we describe inspectively, except where we use the results of our former inquiries; for operation involves no new existences and no new organizations.

As for the psychologist's means of obtaining the functional facts, there stands, besides the fruits of "inspection" of the bodily structures and the mental qualities, our method of the "commentary." We saw at the very beginning of our

inquiry that inspection and comment are the two coördinate means for the observation of psychological facts. Since the study of function comes after the inspective description of the organism it only remains to identify those factors and then to regard the performance by way of "comment." Fatal as a substitute for description in attributive terms, when in search of the mental qualities themselves, the "commentary" is of the greatest service to the student of function.

Unlike inspection, which is reported only by the observer, comment upon the functional performances is made both by the observer and by the experimenter. Suppose that we set out to investigate the variable course of action under an ergographic control that arranges for the repeated lifting of a weight suspended from the middle right finger. The experimenter will observe the performance, noting the observer's unintentional shifts of position, his substitution of one muscle-group for another as fatigue enters, the rise in pulse-rate or the change in blood-pressure, modifications of breathing, and the appearance of such accessory functions as the setting of the jaw or the bracing of the legs. Besides these facts the experimenter has his graphic records of the rate and amount of pull from minute to minute. On the other side, the observer comments upon an increasing tenderness of the finger under stress, fluctuations of zeal and relaxation, distractions from the task, desire for the end, flashes of surprise, dismay, interrogation and the like. If the experiment concerns the attentive reading of nonsense series, then the observer's comments will bear upon his comprehension of the instructions, the constancy of dispositional set, chance meanings attaching to the nonsense syllables, devices for connecting the syllables in pairs or groups, a whispered accompaniment, rhythmizing of the series, curious combinations of letters, changes in illumination, and so on and on. The volumes of Göttingen studies of association, referred to in another connection (pp. 388, 392), are filled

with commentaries of this kind, out of which has come one of the major achievements in functional psychology.

Comment requires training, quite as much as inspection does; but it is training which lies closer to the careful noting of details in everyday life; and it has much in common with the reports of the observer in physics, zoölogy and chemistry. Since the functions which we are now to study are psychosomatic, the commentary of the observer will be of the first importance. Once standardized in the laboratory it becomes simplified and abbreviated. Experimenter and observer must speak a common language, agree upon terms, and complement each the other in their respective contributions to the problem in hand. In the animal experiment, as well as in many studies of the young and the abnormal, the observer becomes the "subject." His comments are either crude or wholly wanting. Then the source of observation is restricted to the person who is responsible for the conduct of the experiment. When this person is versed in the method of inspection, and also knows his physiology, he can by a legitimate use of analogy and inference sometimes supply the mental factors as well as the functional details, which would be normally included in the comments of the true psychological observer. On the other hand, the "behaviorist" who seeks only to translate *his* commentary and his numerical results into terms of "response" is very likely to neglect altogether the mental factors and so to depend upon an inferential relation between the "stimulus" and the bodily changes which he observes. These bodily descriptions as well as the pure inference from "stimulus" to "response," we shall omit from our own functional treatment.

Classification of the Functions

Although our psychological books and our psychological experiments are, in very large measure, functional, we still have no definite and generally accepted doctrine of function.

Tradition and usage have taken the place of a logical arrangement of the coöperative activities of mind and body. We find separate chapters and separate books devoted to perception, sensation, memory, action, thought, learning and imagination, without any consistent separation of these problems from the sort of inquiry which describes the mental "processes" and their organization.

The word "function" itself is so hackneyed and so ambiguous as to embarrass any attempt at definition. We may come to terms with it, however, by observing that the word may be taken to mean either *a mode of operation* or *a kind of accomplishment.* Consider these meanings in turn. To say that a house may be built by flowing liquid concrete into a sustaining framework or that it may be built by laying up walls of brick in mortar is to indicate two different *modes* or *ways-in-which* a thing is done. That would represent "function" in the first sense. There different agencies are used toward the same end, the building of the house. On the other hand, to observe that firearms are used for the procuring of food and for personal defense against assault is to point to a functional difference of the second sort. There an agency is employed for unlike ends. We say that the gun or the revolver functionates in different ways. So we may say that the mind-body works in two *modally different ways* in recalling an old solution of a problem and in actually thinking the problem through, in acting from choice and in trusting to impulse. There we consider different functions as different ways-in-which something is done. But when we speak of different ends, as of escaping danger or of adjusting oneself to society or of creating a new code of morals, then function is of the second or accomplishing kind.

Now to depict a function or operation in its own terms is always better scientific method than to substitute for it its end. To say that printing is that process which turns out books and newspapers is not descriptive. It gives no intelli-

gible idea as to how the printing press works. This is the easier way. Means and modes are often fugitive or complicated; whereas products are likely to be permanently at hand for deliberate scrutiny. That is probably the reason why men are prone to refer vaguely to "forces" or "powers" which are supposed to be responsible for the production of some observed result. They are like the physician in Molière's play who gravely explained that sleep is brought about by the action of a *dormative principle* within the body. To say that one instinct tends to preserve the race and another the individual tells us nothing about the instincts themselves. It does not even demonstrate the existence of them. To say that one tribe so conducted itself as to survive while a neighboring tribe became extinct gives us no information upon their modes of living. As a matter of fact, we shall find that the functions which we are now considering have been regarded in both ways, as modes and as accomplishments; but more frequently in the second. We shall prefer the first way, however, and we shall give notice of any departure from this meaning of the troublesome term.

Our first great embarrassment in the quest of fundamental modes is due to the remarkable versatility of the human organism. Man "turns his hand" (so to say) to the most widely diverse performances. Besides supplying those primal wants and necessities which he shares with many other animals, he reads, writes, talks, thinks, plans, constructs and joins his fellows in hundreds of coöperative projects. *How* does he accomplish all these things? How many unlike modes and means does he possess and employ? Does he do every different thing in a slightly different way, so that his psychosomatic resources equal in number his accomplishments? It is obvious to all of us that he bends one and the same means to the accomplishment of different ends; and it is just as obvious that he is also able to reach one and the same end by the employment of diverse means and agencies.

Let us see what the ultimate nature of his resources really is.

The Psychosomatic Modes of Operation

The quest for the final terms in performance, for the basal functions and capabilities, is very old; and as we have before had occasion to observe, the assumption of powers, faculties and capacities has usually taken the place of empirical observation of the actual concrete modes.

One of the oldest of the functional distinctions in psychology separates willing from knowing. These two capabilities were long regarded as the primitive and elementary resources of mind. Since this distinction was observed for centuries without leading to any comprehensive understanding of what mind is, it would be foolish for us to adopt it. One defect of the distinction is that it credits mind with vague and undefined powers which mind does not possess. Another is that knowing and willing are abstractions which were assumed by the "faculty" psychologists to be actual and concrete possessions of the soul. In the third place, the distinction was made in the interest of philosophy and morals more than in that of psychology. Even when "feeling" was added to the other two faculties (about the end of the eighteenth century), the condition of psychology was not much improved. These venerable distinctions have been preserved in a somewhat disguised form by recent British writers under the names of "cognition," "conation" (a kind of primitive will or effort), and "feeling"; but even in this disguise they have added little to our accurate, descriptive knowledge of mind and of its offices. Another way of settling the fundamental question of function has been suggested by the French philosopher Bergson, who distinguishes instinct, a sudden kind of total and unreflective insight, from analytical thinking, a laborious splitting up of the world in the form of knowledge. Some psychologists have given up the distinction among primary powers, retaining only one. Herbart long ago called it the power of "presentation," and Angell, in our own day, has held to an ultimate capacity or faculty for analysis and synthesis which he calls "attention." Most of the modern interpretations of function describe it in terms of general biology or of physics. Thus the process of

"adaptation of the organism" is one popular way of conceiving the offices of mind, the conception of "drives" and "urges" is another, and the notion of mind as something which "reacts" upon or "responds" to (as if awaiting) stimulus is a third. Most of these modern conceptions are of the old faculty sort. They seem to be more "scientific" because they use the terms of the physical and the biological disciplines. As a rule, they presuppose the ancient magical belief in separate and special powers of a mind which they do not describe; but sometimes they hand over the reins of government to the body, admitting apologetically a kind of shadow-mind which apes the powers and the postures of the real and efficacious substance to be found in cell and tissue.

To say what the final forms of operation are is not easy. Doubtless the persistent searchers for a few elemental modes were on the right track. The history of life does not suggest a different provision for every new emergency or demand. The preparation of various foods in a great many animal forms is accomplished by one and the same digestive means; and the same muscles and tendons functionate under the same type of neural control for all the kinetic operations of the body. It seems reasonable, then, that the total organism, the mind-body, should possess a limited number of functional operations. Let us permit it to speak for itself; to suggest its own functional modes. The two most fundamental derive from the meaning or "referring" side of the experiential structures, on the one hand, and from the energies of the nervous system, on the other. The primary meaning of our mental structures is perceptive. The primary display of energy from the neural reservoirs is motor. On the one hand, the total organism perceives its surroundings and, on the other, it acts with respect to them. Apprehension and action thus stand as the most primitive and simple of our operations. It is likely that at an earlier stage of animal life the two functions were coincident, that the first operations involving these double resources were perceptive actions. Then the organism would, by a single per-

formance, exert its mechanism in the direction of a given adjustive end which was vaguely and dimly represented by an apprehended object or quality. In us the operations of acting and perceiving are modally different (as we shall presently see), although they are at times intimately associated.

But the human organism has other functional resources as well. The indicatory or "gauging" side of mind adds to action a new but closely related form of executive function, the emotion. Emotion implies feeling, and feeling is the register, as we have seen, of the vicissitudes of life as these affect the general temper of the nervous system. Emotion usually incorporates within it some form of apprehension; for we are "moved" by the sight of a cruel action, by the recall of the exploits of our youth or by the creations of fancy. But in its total functional mode it is of the same order as the action, the predicament within it suggesting a resolution through movement but through a movement which fails to resolve the impending situation.

The apprehensive and the executive functions keep the organism close to the concrete. To deal generically and abstractly with its world and with itself other resources are required. These appear in comprehension and in thinking. In comprehending the organism proceeds topically. It understands. It grasps directions and it develops subjects of discourse. In thinking it departs still further from the individual and the concrete, setting up problems which it solves by the use of symbolical meanings. Both comprehension and thinking wear the appearance of exalted accomplishments; but they put under requisition, as we shall see in the sequel, just the same resources of body and mind that serve in its simpler operations. Both demand, to be sure, high and precise organization in experience, abstract and refined meanings, delicately balanced stores of energy and carefully directed avenues of neural discharge; but neither calls for any

novel resource either in the bodily mechanism or in the form of mental qualities. The only novel aspect is that of function; a new way of using materials at hand for the attainment of more complex and more remote ends.

We may distinguish, then, four functional modes of operation which call upon the combined resources of the psychological organism. Let us regard them somewhat more closely. First, the organism *apprehends* objects and events. It apprehends them *as present;* the wall yonder, the buzzing bee outside the window, the music from the adjoining room, the opening of the door. It apprehends them *as past;* the play of last evening, the looks of the melon upon the breakfast table, the echo of a recent conversation, the thrill of one's first railway journey. It apprehends them again in *imagination,* as future, as conjectured, or as supposed; the appearance of the hall before we open the door, the probable appearance of a correspondent whom we have never met or the crisis in the novel which we are now reading. Always laying hold of, seizing, getting at, apprehending. That is a distinctive performance in which both bodily and mental factors are invariably conjoined.

Secondly we consider the *executive* kind of operation. As we have seen, it frequently runs on with apprehension; although it is distinct of its type and is capable of an independent course; as when we walk by night maintaining a conversation or anticipating a difficulty to be met in tomorrow's business. The varieties of action include impulsive, deliberative and selective forms; to which are added the confused and abortive emotions of fear, rage, anger, jealousy and the rest. The distinctive aspect of the executive functions is the "determination" or the "predicament" which carries them along. The action progresses under determination; the emotion gradually resolves its predicament and dies out.

Closely related to these—indeed, resting upon them—is the third group of *comprehending* functions. In comprehension

the psychosome does not stop at the mere laying hold of objects or with a survey of the furnishings of the world. When we comprehend we grasp situations; we get hold of significant relations; we discover; we inform ourselves. In that sense we understand. The comprehending functions are widely exercised in listening to lectures and in reading expository writing. Without actually thinking a matter through with independence, we acquire in this way the fruits of the thinking of others, and so, in a sense, we make our own the accumulated lore and learning of the race. This function, which is, as a rule, more abstract than perception, memory and imagination, makes good use of language and other condensed means of knowledge. Its simple beginnings are common among the higher animals; but it is well developed only in man. Upon it rests, in a large measure, the ability of the human race to amass and to preserve customs and prescribed forms and thus to establish a "social tradition." When we come to a descriptive study of it we shall find it to include much that is known in the laboratories and in the school room as the "process of learning." Its cultivation is of great importance in educational theory and practice because it calls for the most effective incentives and motives to the reception of knowledge and the understanding of the world.

In the fourth place stand the *elaborative* functions of thought. The essence of these operations we have seen to be the solution of problems by the aid of symbols. By means of them the mind-body advances toward a thought-solution. By them the student of geometry solves an original problem, the manufacturer reflectively seeks a new means for increasing his net profits, the inventor "puzzles over" a mechanical difficulty or the baffled attorney the legal defense of a difficult case. It is "hard thinking." By its exercise we acquire something more than mere "adaptation," more than the getting on by lucky hits or advice or simple infor-

mation. Its fruits differ from those of comprehension. When we elaborate or resolve always we first formulate a problem and then proceed to solve it. It is different from memorizing and different from the acquisition of skill. It is, however, one of the determined operations, which ends only when the solution is reached and belief, conviction or discovery attained.

One by one we shall, in the sections which follow, examine the psychologist's knowledge of these conjunctive operations. Before we proceed to the exposition, however, we must dwell again upon the question of method, which is of the first importance for all functional studies.

How can our radical functions be described? How can the psychologist depict perceiving, remembering, thinking, and the others? At first the problem may not seem to you to be real. In our everyday concern with these things, we refuse to make a mystery of them. We say, *e.g.*, that mind is the kind of efficient agent that *can* perceive, remember and think. These things do somehow get done, and we are content to credit the mind with the power of doing them. This is common sense; but it is not psychology. We have seen before that it is neither scientific description nor scientific explanation to create an agent which shall have the ability to do that which we see *is* done. That simply—as we have observed—is to name a mystery and then to persuade ourselves that somehow we understand it.[2]

[2] The difficulty is real enough to the philosophers. Consider the first and simplest of our functions, perception. How a living being can know an object which is unlike and separate from that living being, they are not agreed. Their solutions, which do not concern us here, are various. They mean to explain the fact of knowledge. That is not our problem. The terms which they use, "sense data," "sensory contents," "awareness," "consciousness of objects," are not our terms. We know that objects are, as a matter of hard fact, apprehended, that actions are carried out, that thinking reaches its goal. Our task is to see how these facts can be stated in descriptive terms.

We must repeat that our functions are not to be thought of as mental "processes" or qualities of existence. In Part I we examined all of the mental materials that are known to observation, and these things were not among them. We might say that we are "conscious of" perceiving, thinking, etc., as we say that we are "conscious of" rocks and buildings, of chairs and tables, of cars running and water flowing. After all, we only mean by "conscious of," in the latter cases, that we apprehend these things as here in their places at this moment or as going on. To be "conscious of" does not add anything to this simpler statement. So we might say—without making any mystery—that, perceiving or thinking is going on. But that simple admission does not tell us in what terms it is appropriate to describe these procedures. The description is appropriately made, as we have already indicated, only in terms of operation or function.

No new "introspection" of a perceiving or of a remembering is to be undertaken. There is no "inside" substance to see, even if we could "look inside" a mind. Inspection has already given the qualities, the structures and the bodily organs involved. It never reveals an "operation" or a "performance." We only look upon these matters now in a new way. The character of the agency is, then, to be described, the conditions defined, and the rate, order and manner of the procedure reported in the "commentary" which depicts the "going on" of the operation; very much as the functional account of printing would depict the passage of the paper under the cylinders, the inking, the movement and cutting of the rolls, and the final delivery of the finished sheets.

CHAPTER IX

THE MODES OF APPREHENSION: I. PERCEPTION

The Psychologist's Way of Regarding Perception

It is common to find perception treated either in the logician's way, as a form of knowledge, or in the biologist's way, as a device for living. Both ways regard rather a result than a procedure. The first explains that perception turns out knowledge of a certain sort; the second that it enables the organism, by an immediate perspicacity, to obtain food, to adjust itself to natural changes, and to escape dangers. Now and then an author, following Herbart and Wundt, describes perception as an arrangement of mental "processes" and so speaks of "fusions" and "colligations" or of "qualitative," "spatial" and "temporal" perceptions. Here the integrative aspect of experience is confused with performance. Our own endeavor will be to avoid logic, biology and forms of integration.

Common to all perceptions is the fact that the objects and the events are apprehended as *present* and as *going-on-now*. So they are distinguished from memories and imaginations. "Presentness" is, then, so to say, written across all perceptions. It does not matter what means and devices the organism has recourse to, whether the organs of sense, the apparatus for movement, the brain, qualities of sight and of hearing, somæsthesis or sensimages, so long as an object or occurrence is apprehended as of the time-being.

The perceptive quality of "being present" should not be confused with reflective judgments about the temporal placing of our objects; as if one were to say "Yes; my inkstand here or the

traffic in the street yonder belongs to the present day and hour and not to things and affairs of former or of future days." That reflective placing is not the ear-mark of the perception. Our immediately inscribed "presentness" is the actuality of the perceived object, the temporal of-courseness which makes the object a part of the furnishings or the proceedings of the perceptually real world. The imminent objectivity of all that we thus apprehend is so constantly taken for granted that we may be inclined for a moment to doubt its existence. When we are, a simple comparison of one's present hunting coat, motor car or dining table with similar objects remembered as figuring in one's past experience will at once set in relief all that is implied in the "presentness" of perception.

We cannot fully appreciate the psychologist's view of perception until we have discovered that the meaning of "presentness" rests upon something much more primitive in experience than the physical actuality and the independent existence of the objects which we constantly see, hear and handle. Although our study of history must be reserved for the genetical sections, we here observe that the specific meaning or reference in perceptive experience is not original but has grown up little by little throughout the individual's life, and throughout the vast life of the race. This fact of genesis and growth will help us to understand certain simple and primitive experiences which lie at the root of the perceptive function.

Let us illustrate by reference to the facts of vision. The psychologist has recently learned that when he wants to observe the color qualities in detachment from colored objects and sources of light he can conveniently do so by cutting a clean circular opening in the center of a large dull gray cardboard screen behind which at a convenient distance the colored object is placed. When the round opening is observed from before the screen the color (which should be homogeneous and should completely fill the opening) wears a curiously detached appearance. It becomes the

"film" color or color-curtain (p. 58). It no longer stands at a given distance or forms a "surface" or crust upon a colored cube or other solid object. It is neither flat nor tridimensional. Its distance from the eye is indeterminate. It is called pre-perceptive and pre-dimensional color. It is this kind of quality which the psychologist regards when he makes up his color-pyramid (p. 57). To observe it in its "purity" requires training in order to free it from the "objective bias"; but no more than the observation of the human viscera requires to be freed from the emotional bias of the layman.

Here we have a "presentness," *e.g.*, a "red presentness," but very little more. Suppose now that we import a particular perceptive motive by reaching a long rod through the circular opening and extending it to the colored surface. The sight of the rod, pressure from the hand and strain from the tendons presently enable us to *place* the redness, which becomes "a red thing there." Now let us cast from behind the screen an uneven light upon the surface, making one side bright and the other dark. New perceptive qualifications arise. The surface takes on texture, brilliancy and shadow. One side seems nearer, the other farther away. Once more, we may tap the surface from the rear, visibly jarring it and also apprizing the observer, through the sound, of the place whence the jar arises.

We only need further to provide, by some suitable means, for a gradual enlargement of the circular opening to restore at last all of the full perceptive meaning with which we started when we first turned our naked gaze upon the colored object.

Chance experiences will supplement for all of us this account of the gradual extension of perceptual knowledge. The momentary glimpse of an unknown object seen in a dim light, strange noises heard on the plains by night and unseen objects passed hurriedly over the palm of the hand

suggest how meager and how plastic perception may be. When once we realize that the perceptive meaning which we acquire upon a given occasion depends upon the exact resources which the organism has at its command, bodily and experiential resources, then we have come face to face with the central psychological problem of this apprehensive function. That a delicate and precise use of these resources is essential to stable and adequate perception is suggested by the ease with which we fall into illusion upon the spatial qualities of objects and upon the direction and rate of movement. That we perceive distance and motion best through the eye; weight, inertia and composition through the hand and arm, and music by way of the ear is not a matter of chance but of the exact adjustment of the means of the organism to the perceptive task in hand. And that the object cannot be merely regarded as a "stimulus," impressing its character upon the receptor organs, we know from our study of the organization of experience under central, as well as peripheral, conditions. The unitary functioning of the central nervous system is always implied; sometimes by supplying sensimaginal qualities (as in our mixed incorporations) and sometimes by merely giving an unique configuration or structure to the primary qualities of sense. Perception in ourselves we must regard as the outcome of a long period of trial, success and failure during which certain devices have been tried and rejected and certain others encouraged and brought to a functional efficacy through years and ages of individual and racial development.

The classification of perceptions is primarily a matter of convenience. Since the general mode is always the same, no matter what means and materials are employed, the varieties will be subject to a somewhat arbitrary choice. Our chief problem will be to note the conditions, bodily and mental, underlying the perceptual performance and to report variations in the character, the amount, and the accuracy of

the operation. And since certain physical and extra-bodily facts are also involved (*e.g.*, the light-pattern upon the retina, the wave-trains striking the inner ear, the chemical substances acting upon the tongue), we shall have at times to include these also among the essential conditions.

The Perception of Objects

Although the apprehension of our more static and permanent surroundings (streets, trees, mountains, furniture, buildings and the rest) is closely and ultimately bound up with our perception of movement, we may, for the convenience of exposition, separately treat the two kinds.

Immediately we come upon "space," for the largest part of our object-perceptions have been cast in a spatial mold. So far has man gone in his abstract consideration of space, regarding it separately (in his geometries and in his theories of the universe) from any particular kind of filling, that we must keep clearly in view the fact that most of our common perceptions into which space enters are the perceptions of the spatial qualifications and the spatial relations of objects and events and not perceptions of mere or "empty" space. We commonly perceive short and long, large and small, pointed and blunt *objects,* objects here and there, objects existing side by side, objects at rest and in movement, not disembodied length or size or place or movement. We come, then, immediately to the conditions under which spatially qualified objects are perceived.

These conditions we shall the more readily comprehend when we have fortified ourselves against two common errors under which we all fall early in life. First, we grow up with the tacit understanding that the objects which make up our surroundings are just "there" more or less permanently and that we know them by simply opening our eyes, our ears, and other avenues of sense to allow the objects (or the knowledge of them) to walk into our "minds." Of

course, when we reflect we see that neither an object nor a copy of it nor again the ready-made knowledge of it could enter the eye or the ear and travel along neural fibers—fibers which only suffer a chemical or molecular change of state under change of stimulation and do not "carry" any thing or any "message"; and when we further reflect that such a thing or message would have to be transformed into a physiological process or condition, that it would not come finally in the head to a recipient "mind" which awaited it, but only to other neural tracts and pathways of discharge, we realize that the easy solution of naïve common sense is no solution at all. Instead there exists, even in the briefest and simplest perceptual experience, a complication of factors which must be described in the terms of the physicist, the chemist, the physiologist, and the psychologist. We must, then, start with the experience as it is given and proceed to factor it and to discover all the conditions which are relevant to our undertaking.

The second misapprehension, one which we have already taken steps to remove, is that our perceptions are as fixed and permanent as we suppose the objects perceived to be. To realize the fallacy of this second supposition we have only to choose such an object as a house or a statue and then slowly to walk around it fixating it as we go. At every step our view changes; although the object is one and the same. Every new view is a new perception, one perception gliding imperceptibly into another. When we close our eyes the perception ceases; when we open them again, the perception is renewed. Perceptions are, then, operations which have a beginning, a course, and an ending. Moreover, as our acquaintance with a given object increases, the perception is constantly modified. Try to perceive the table silver as you perceived it when an infant elevated to the high chair, the reagents upon your chemistry desk as you regarded them upon being first assigned to your place in the laboratory,

your own home as you approached it for the first time. Compare the child's apprehension of a plain gold band with that of the bride, or the surgeon's perception of his operating set with that of the patient. Compare the telegrapher listening to the click-click of his instrument with the chattering sound which you yourself hear as you enter his office to send a message. Perceptions constantly grow, change, shift; they are in flux; they begin, run themselves off, and end. In short, they are functional events.

Further to realize the impermanence and mutability of perceptual meaning you have only to repeat for minutes together some compound word, say, "household" or "tongue-tied." Presently the halves of the word fall apart and the total significance disappears; then the syllables become unfamiliar and finally the whole is resolved into an uncouth jargon of meaningless sounds. Even faces stared at intently from a short distance tend to lose their familiarity and their significance, and are replaced by vague fragments. An inverted picture fails to supply the proper conditions for the visual perception of a landscape and likewise falls into a hodge-podge of sketchy outlines and masses.[1] In certain pathological disturbances of perception the object seen, heard or explored is without class or meaning; and an emotional shock has been known so to disturb these functions that familiar objects appear strange and strange objects familiar. Such a disturbance is related in Joseph Conrad's *Youth,* where the second mate upon a coaling vessel, blown up in mid-ocean, describes his confused state after the explosion.

Our present task, then, is to see how the mental and physical factors coöperate in the apprehension of spatial ob-

---

[1] Pillsbury speaks of the "transformation of the sensations into objects" (*The Fundamentals of Psychology,* 1916, p. 269); but surely sensations are no more "transformed" than are the excitations in the optic nerve or the cerebral dispositions; all are necessary, though diverse, conditions underlying perceptual apprehension.

jects and events.[2] The organism's resources are all described in our earlier sections. They are (1) the component qualities of experience, (2) the organized patterns into which the qualities are integrated, and (3) the bodily organs and processes brought under requisition. By way of *materials,* therefore, we shall discover nothing new.

1. *Are there psychological "dimensions" of space?*

The most obvious way to factor "space" is to reduce the ordinary "three-dimensional" world of our common experience first to two dimensions, the surfaces, and then to one, the points. But this kind of reduction, although it has often been attempted, has no real significance for us. It is geometrical, not psychological. The surface may be mathematically simpler than the solid; but it does not denote either a simpler function of the organism or a more ancient achievement of the race.

Some writers start with an original spatiality which they call "outspread," "extent," "bidimensionality" or "Flächenraum," from which they seek to derive "tridimensionality" by adding a third determination, "distance" or "depth." This conception opens the door to various confusions. (1) If the "extent" is an indefinite and unlocalized wall parallel to the organism and possessing only a right-left and an up-down, then the in-out dimension, "distance away from us," has to be explained. (So Titchener, *A Textbook of Psychology,* pp. 303-306, who derives chiefly from Ebbinghaus, *Grundzüge der Psychologie,* 1911, Vol. I, p. 469; 1913, Vol. II, pp. 37-43, 121*ff.*) But an outspread without thickness would seem to be a geometrical abstraction, not the attribute of a mental quality. (2) The "original extent" con-

[2] Instead of searching for these concrete resources, psychologists have frequently raised the question whether space is "native" to the organism or "acquired" from racial experience. The long and involved debate between "nativistic" and "empiristic" theories has no value for us. Whatever relevant material we can find bearing upon the origin of the spatial perceptions we shall reserve for the discussion of the history of mind. Our own present inquiry is factual, not speculative and metaphysical.

fuses analysis with genesis and history, wholly different matters. Although Ebbinghaus and Titchener profess to be making a mental analysis, they are really discussing the problem of how an organism can "perceive all three of the dimensions of space" (Titchener, 306). By bringing space into mind in the simple (?) guise of "extent," they seemed to avoid the "mental chemistry" of Mill and of Wundt. "Mental chemistry" would appear, however, to be opprobrious only on the assumption that everything in perceived nature must find its counterpart in "mind." That assumption seems to be a vestige of the "copy-theory" of knowledge. Our doctrine that perception is as truly a function of the *bodily* as of the mental factors to be observed should remove the assumption and extract the sting of reproach from "mental chemistry."

Again, the three dimensions themselves with which the psychologist is prone to begin his analysis are, for our purposes, little more than a convention. When we candidly observe the directions in which objects actually lie, we see that these directions are very many. With a great deal of detail in your present surroundings, about, above, below, near, far, you may be able to distinguish hundreds of directions. The fact that all of these directions can be *mathematically* defined by three lines crossing each other at right angles has nothing to do with the psychological analysis of space. In fact, it is not an analysis of space at all which we desire, but a statement of the organic conditions under which the spatial apprehension arises. In so far as space pertains to objects it is as much a part of the *meaning* side of the perception as is material or movement; and as attributive to experience it is, as we have said, a pre-dimensional voluminousness.

When we leave the spatial husks and the mathematical objects and abstractions and return to perception and its problems, we find—to repeat—that we have to deal with the present apprehension of objects which are near and far, large and small, broad and narrow, right or left, up or down, and which are definitely placed within the total mechanical world. The spatial peculiarities qualify objects just as much as do their color, their weight, their construction, and the uses to which they are put. *All* of these qualifications

appear, when viewed from the standpoint of the psychologist, as meanings, as references, which sustain only a functional relation to the organism itself. And we must remember that, for the actual perception, the spatial qualifications do not stand alone; that the bookcases, for example, which stand yonder against the opposite wall are not mere long, narrow forms occupying a rectangular space; they are perceived as "those bookcases filled with books." If we abstract from this concrete meaning, as psychologists often do, and treat only the geometrical properties of them, we shall at once incline toward the abstractions of geometry and away from our psychological task.

Let us try to find the actual factors involved. Suppose that we set before us upon the table this heavy and substantial bit of marble, a small replica of the Greek Venus of Milan. What exactly is involved in its perception? First, on the side of sheer quality, we discover the grays, blacks, and whites of our first section. As our gaze rests upon the figure, the eyes move jerkily, fixating one point after another and so modifying the visual factors. With the shift in fixation there arise kinæsthetic qualities from the eye-sockets and the muscles about the forehead. These materials are enriched as we pass the hand over the surface; an exploration which also adds pressures from the fingers and hand. To all these primary qualities will be added a variable number of sensimaginal factors according to the experience and the predispositions of the observer. The perception is likely to include also auditory and kinæsthetic items which accompany the verbal forms of naming and description. In the second place, the *organization* of the total experience rests upon a primary visual incorporation of the extensive kind. This incorporation constantly undergoes modification as the eyes shift and the exploring hand wanders. Where imaginal processes are present, the incorporations are of the mixed kind; and where the perception goes on to details of

the figure and its surroundings, a perceptual train is established which may run on toward the exhaustion of the object. A complete analysis on the side of organization includes the clearness-degrees of the qualities and the general patterning of the total structure of the moment. In the third place, the bodily factors in the perception obviously include various receptor organs in the eyes, muscles, tendons, and the skin. The favorable setting and disposition of these organs of sense involve secondary devices which serve to increase and to specify the perceptual significance. Less obvious, but quite as important, is the implication of the central nervous system, as well as of the ingoing and outcoming lines of neural conduction. All of these conditions of a perceptual operation are of course ultimately dependent upon the integrity of the body at large and upon the physical conditions of stimulation which lie in the object and in the various media transmitting energy to the receptors.

So much by way of a general indication of the factors involved in perception. The researches of the laboratory upon the subject and the descriptions of monographs and books usually concern much more specific questions. They seek to resolve such problems as the following:

What factors are responsible for the perception of the unlike distances at which two objects may be seen; say, two vertical rods set in perspective before the eyes? How is the position of an object determined in such an auditory perception as that of a boat whistling in the fog or an animal approaching in the darkness? How are unseen objects localized upon the skin? How do the two eyes coöperate in the perception of depth, of distance, and of form? How delicately may sizes be distinguished by the fingers or the tip of the tongue? Why do we invariably overestimate vertical distances? What are the essential ingredients in the perception of the movement of objects seen or of objects explored by the hand? How accurately do we apprehend the duration

of events? How keenly do we detect variations in rhythm and melody? The range and variety of these questions will suggest at once the richness and the difficulty of the experimental field of perception. Our further discussion must be limited to a few of the typical problems and solutions. It is clearly impossible in a survey to cover the entire list.

2. *Illusions*

The illusion, sometimes called a "sensory illusion," is an inadequate perception, *i.e.*, the perception is inadequate to the object apprehended. Inadequacy may take the form of ambiguity as in Necker's cube, where the skeleton object is seen either as sitting upright upon the base or as poised upon one corner, the ambiguity depending upon the mental and organic conditions of the perception. It may take the form of overestimation or underestimation, as in the arrowhead illusion or the contrastive ring illusion or of the wrong placing or wrong direction of an object, as in the bent rod in the water or the common Zöllner pattern, or of size, as in the exploration of a dental cavity by the tongue, or of height, as of a tree or flagstaff.

So complex and so variable are the conditions of perception, especially of the spatial peculiarities of objects, that we are constantly falling into, and as constantly correcting, illusory apprehension of the common objects about us.

The chief value of illusions to the psychologist lies in the fact that they suggest a refined description of the perceptual functions. They tempt him to vary the conditions and so to vary the perception. If a small toothed wheel passing by discrete jumps over the skin or a series of flashes from a moving-picture film striking the eye sets up a perception of movement, he is led at once to ask what the essential conditions of movement as seen or "felt" are. And not only led to ask; the means for varying the size and the rate of the wheel or of the flashes help him to discover precisely what

conditions, mental, organic, and physical, have to be fulfilled to produce the observed effect.[3]

We must allow perceptual apprehension of one kind or another to a good many of the animals; but the character and the extent of it doubtless vary within wide limits from

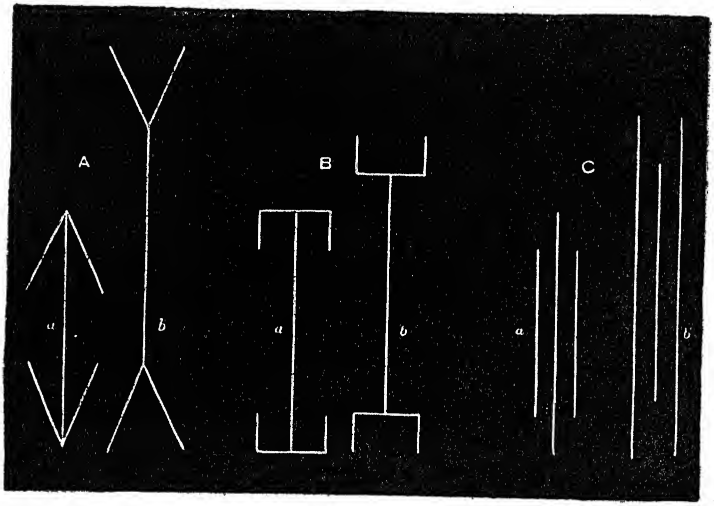


FIG. 27. THE MULLER-LYER ILLUSION OF LENGTH

The verticals in *A* and *B* and the middle lines in *C* are all drawn to the same length. From E. B. Titchener, *Experimental Psychology* (Macmillan Co., 1901).

one form to another. The enormous range of human perception far surpasses that of any other living being. It seems to have been chiefly determined, however, by only two or three favorable circumstances. In the first place, by the wide variety of man's inventions and manufacture. The human

[3] At times the psychologist has taken all of the illusions together and has tried to evolve a theory of them. He has never succeeded, however, for the simple reason that one set of conditions produces one illusion and another set another. For a review of the theories *see* H. Ebbinghaus, *Grundzüge der Psychologie* (1908), Vol. II, pp. 82-121.

world is full of the most varied objects to be perceived. In the second place, by special organic devices; the upright position which gives to the eyes a commanding view and to the hands and arms freedom for manipulation, and the double sense organs of sight (binocular vision) and sound (binaural hearing). As regards the first, we can imagine the impoverishment of perception which should follow the loss of mechanical construction (furnishings, implements, tools, artistic objects, etc.) and the destruction of all those devices, as the telescope, microscope, phonograph, photograph, moving-picture, which extend our perceptions to the vast, the distant, the minute, the past, and the absent. No age and no region have exalted and expanded, so much as our own, the realm of perception. As regards the organic devices, no other animal is so well designed as man to specify and to break up the world by perceptive analysis. Other animals (*e.g.*, the ant and the dog) have gone further in the use made of an olfactory apparatus, although it does not appear that man could not surpass even here, were the conditions of life favorable; but the free use of the eyes as instruments of survey and analysis have carried human perception far beyond that of any other creature. It seems also necessary to add certain central or cerebral changes, not well known, which have enriched perception from the side of sensimagery and from momentary and persisting central dispositions

3. *Binocular Stereoscopy*

Consider the significance for perception of the two movable eyes set well forward in the head to permit at once a common field of vision and unlike views of one and the same object. A large cyclopean eye set in the middle of the forehead, present in some insects, would have missed this double view; and such eyes as the alligator or the hippopotamus possesses, set distantly at the two sides of the head, would have missed the common field of regard. Doubtless there are occasions

when it is useful to the reptile to view first one river-bank and then the other; but we can scarcely imagine the delicacy and precision of human vision coming from the reptilian arrangement.

Let us see just what this binocular device does for visual perception. We might expect that the double eye would somehow intensify our visual qualities, making colors more brilliant and lights more luminous. It does not. When you look at white paper or red cloth, covering first the right and then the left eye, you discover that either eye by itself gives the same color and the same brightness as both eyes together.[4] On the side of quality, then, the two eyes add nothing that is not given with one alone. Just so the two ears add little or nothing to the intensity of sound. The advantage comes from another direction; a direction which you will apprehend if you will hold your forefinger upright six inches before your face and stare intently at the wall beyond it. As you close first one eye and then the other, you will notice that the finger seems to jump to one side and then to the other, and also that you first see it (with the left eye closed) from the right side and later (with the right eye closed) from the left side, *i.e.*, the direction is different and the point of view is different. The stimulus patterns upon the two retinas are different and the two separate monocular perceptions are correspondingly different. When the eyes are stimulated together, however, the observer does not see two objects, neither does he acquire the two monocular views, either simultaneously or in succession. He sees one object, as in monocular vision, but with a different meaning. He sees the object in its proper perspective and with its proper "depth" or solidity. To realize how much binocular vision adds to our knowledge of near-lying objects you have only to

[4] We may neglect monocular color blindness, as well as the rare cases where color or light vision is slightly different with the two eyes.

ask some one to dangle a threaded needle before your closed eyes and then to call to you to open one eye and look when the needle has come to rest. If you do not see the supporting hand, you will discover that you cannot accurately estimate the distance of the needle from your face; but so soon as you look with both eyes the needle is immediately and exactly placed.[5] This is a striking demonstration of the fact that visual or other mental qualities may bear different meanings, different significances, when bodily processes which unite with them in function are different. Helmholtz and other students of vision have thought that the mind must somehow have two unlike monocular pictures which it then either snaps together or uses in an "unconscious inference" to acquire depth or solidity. The facts do not support this view. There is no snapping and there is no inference. When we once get beyond the delusion that "consciousness" is a separate device for knowledge and observe the actual bodily and mental conditions of apprehension, we find, as in this case, that the perceiving is really psychosomatic. Although, as we have seen, meaning appears only when mental factors are included, it may change as the bodily factors, only, suffer modification. This sort of dependence we also find outside psychology. For a ship to float water is necessary; but the rate and direction of movement depend upon something beside the water.

Stereoscopic vision is most beautifully illustrated by the ordinary double flat drawings which spring into solid objects when placed in the common Brewster stereoscope (Fig. 28). The figures are differently drawn, as you will see upon close inspection; but the difference disappears in the view, and instead of the meaning "two slightly different flat figures," we have in our stereoscopic perception "one pyramidal ob-

[5] To demonstrate the difference bring up your own index finger from below to the precise spot where the point of the needle appears to be.

ject." [6] In making up slides by photography the camera may be placed first to the right and again to the left of the view of the object which is sought; but usually a double camera is used. The difference in position may be considerably greater than that between the eyes (interocular distance), thus exaggerating the disparity. In this way the depth values of

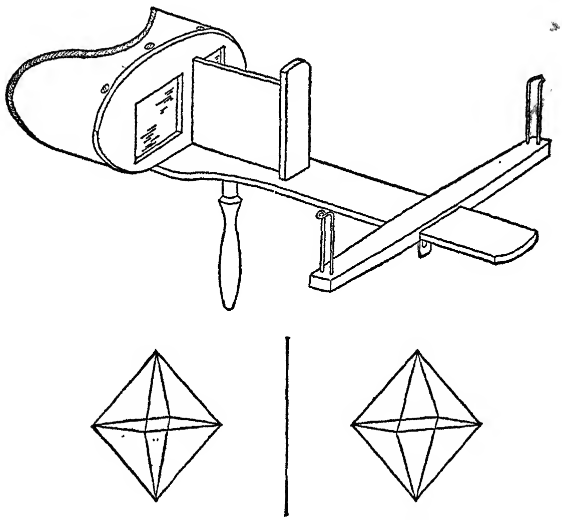


FIG. 28. THE BREWSTER STEREOSCOPE AND A SAMPLE SLIDE

Prismatic lenses bring the slightly different stimulus patterns to the right and left retinas. From E. B. Titchener, *Experimental Psychology* (Macmillan Co., 1901).

an object situated a long way off, too far for direct stereoscopic vision, may be accentuated in the photographic reproduction. A simple instrumental device for demonstrating this effect of great disparity is the telestereoscope. Here two inclined mirrors placed before the two eyes give the effect of

[6] Other factors in the perception of depth are supplied by the accommodation and the convergence of the eyes.

viewing the object with the left eye taken from its socket and held at arm's length upon the left and the right eye at arm's length upon the right. The result when one looks straight into the instrument is to produce curious distortions of perspective.

The microscopist has lately made use of the stereoscopic perception by devising binocular eye-tubes for his instrument. By their aid both eyes are used and the tiny objects in the

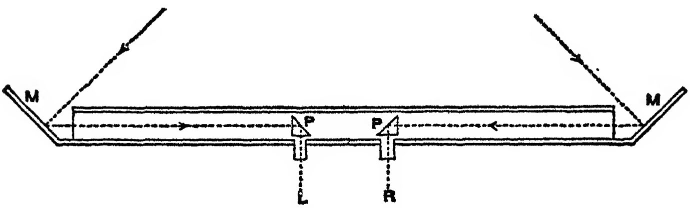


FIG. 29. THE HELMHOLTZ TELESTEREOSCOPE

The rays strike mirrors at *M* and totally reflecting prisms at *P* before reaching the eyes at *L* and *R*. From E. B. Titchener, *Experimental Psychology*. (Macmillan Co., 1901).

field of vision are seen in their proper depth and perspective. Attempts made to add true stereoscopy to the moving picture, so rendering the shifting scenes more lifelike, have met with great difficulties. Perhaps that is not of great practical importance because the photographs impressed upon the film preserve the natural distribution of light and shade, the relative size of objects, change of position, atmospheric haze, and other aids to spatial perception (the "secondary criteria" of distance, as they are called). It should also be observed that the retinal disparity, which comes from the right and left views of objects, is sufficiently marked to give a depth meaning only when the object seen stands at a short distance from the observer.

A great disparity in the two views sometimes leads to a doubling of the object. Hold two pencils in line before the eyes, one six inches away and the other fifteen inches. When

you look at (fixate) the one pencil, thus bringing its light to corresponding areas of the two retinas, you see the other pencil as two. The unfixated pencil is said to fall into "double images." In fact, most of the field of vision is at all times properly disposed for double images; and nevertheless we do not see unfixated objects as double. We have no reason to believe that the doubleness is actually there but neglected. Remember that "doubleness" is meaning, not mind. What the large retinal disparity, which may *upon occasion* lead to the doubling of objects, usually does in the perception is to give unfixated objects their correct place and perspective in the entire field of vision.[7]

Besides the disparity of the retinal images, *i.e.,* the slight unlikeness or unlike spatial disposition of the two stimulus-patterns for vision, the devices for movement of the eyes play an important part in determining the spatial meaning of objects both near and far. When a fixated object approaches the face, the crystalline lenses of the two eyes bulge under the action of the ciliary muscle and also the eyes turn inward (converge) toward the nose, thus keeping the stimulus-patterns upon the foveas or areas of clearest vision. These physiological (motor) changes bring into existence additional mental qualities (strain) which modify the spatial meaning; but in part they seem also to modify directly the meaning which attaches to the visual qualities themselves. Finally, we must not lose sight of the fact that the spatial perception of distance is largely dependent upon functional

[7] Even fixated objects may appear double under alcoholic intoxication, which interferes with convergence of the eyes. Any multiplication beyond two is sheer fancy or else due to a muddled state which makes counting uncertain. Pillsbury says (*The Fundamentals of Psychology,* 1916, p. 298), "Of course all nearer objects (up to a fixation of 2,500 yards) are seen as double." The distance is, as he thinks, "directly inferred." A confusion of observation with logical presupposition! Titchener falls into the same confusion where he speaks of "habitual disregard of double images." He tries to preserve both the double-image meaning and the spatial-value meaning.

trends and dispositions within the central nervous system. Two circumstances confirm this dependence in a striking way. First, the unlike visual estimation of a given distance before and after we have traversed the interval by our own efforts, and, secondly, the effect of atmospheric changes upon perceived distance. In the second case, clarity and obscurity in the object directly affect the estimation quite without memorial revival or associative aid. The hazy mountain immediately looks far away; the clear-cut mountain relatively near at hand. In the former case, we may translate the visual experience into revived strains and fatigue and so magnify the distance. Thus the central disposition may either bring into the experience additional experiential items or directly affect the meaning in a physiological way.[8]

4. *Tactual Perceptions*

Tactual perceptions are similar to visual. They are perceptions of objects in their places or positions, of various sizes and shapes, at such and such distances, existing in assignable directions and under movement. In fact, we know that persons permanently deprived of sight from birth apprehend by tactual means all of these spatial qualifications of objects. The dermal mechanisms, then, taken together with central nervous processes and with the sensational and sens-imaginal qualities which derive from tactual stimulation, are adequate, as vision is, to the various spatial apprehensions. Nevertheless, a comparison of tactual with visual perceptions brings out three striking differences, to-wit: (1) the former usually involve non-tactual factors, (2) they refer as a rule to the body and to objects in contact with it, and (3) they are more gross and less exact in their function. Consider

[8] Some writers contend that the perception of space includes a "productive" or "formal" factor, which creates out of the "sensations" a spatial form. *See* S. Witasek, *Psychologie der Raumwahrnehmung des Auges* (1910), pp. 11*f*. Our own notion of mind does not accord with this doctrine of *Vorstellungsproduktion*.

in order these differences. Close your eyes and then ask some one to touch you at random with a pencil point. When the pencil comes into contact with your skin you are likely to "see the place," *i.e.*, the knowledge that the third left finger-tip or the right eyelid or the middle line of the forehead was touched usually comes in *visual* form. Usually, but not always. You may find the words themselves "left third finger-tip," etc., running through in whisper or in "internal speech"; or finally you may find that the localizing is carried by an incipient or imagined pull of the hand to sweep over and rub the place touched, or a shrug of the shoulder toward the place. Thus visual, verbal (generally auditory-motor imagery), or kinæsthetic factors have here borne the chief burden of the apprehensive function. But since the skin has, after all, furnished the only primary and ultimate clew to the place touched (remember that the eyes were closed), pressure qualities would seem to supply the basal elements in the perception. Psychologists have often argued so, and, in order to be consistent, they have endowed the tactual sensations with "place signs" or "local signs," by which locality is supposed to carry the "place" meaning. For more than a generation psychologists turned their attention to the exact determination of these local signs and to the elaboration of theories for explaining them. The commonest method of experimentation was to apply together or in succession the two blunt points of æsthesiometric compasses to some part of the body-surface of a blindfolded observer who had been instructed to report whether one or two places were touched. The smallest separation of the points which was apprehended as two was said to represent the "space-threshold" or the "two-point limen." A better designation would be "the discrimination of place or locality," because it is really the apprehension of two positions or "therenesses" which the observer effects. To speak of a "space-threshold" implies that the points are mathematical points and that the line be-

tween is the smallest apprehendable space. Both assumptions are, of course, wrong.

The accuracy or delicacy of place-discrimination is roughly expressed in the following table, which makes it clear that the perception varies widely at different regions of the body. The compass points were set down together.[9]

Tip of the tongue	1 mm.
Lips (red area)	5 mm.
Cheek	11 mm.
Forehead	23 mm.
Back of the hand	31 mm.
Lower leg	40 mm.
Middle of the back	68 mm.

The significance of these "threshold" values considerably declined when the amount was discovered to be highly variable, depending not only upon the place and the size of the area stimulated but also upon the intensity and duration of stimulation, the instructions given, expectation, practice, fatigue, and various other conditions. In fact, when men came to work with fine stimulus-hairs, exciting only one or two pressure organs at a time, they found that the observer, under the most favorable conditions of successive application, almost always got separate localizations no matter how close the pressure organs lay to each other. More precise and painstaking reports of the observer showed, moreover, that the gradual separation of the stimulating points did not lead up to a single exact position where the "one-place" judgments passed over abruptly to the "two-place." Instead, in a finely graded series, the careful observer reports such perceptions

[9] Reduced from E. H. Weber (*Annotationes anatomicæ* (1832), pp. 50*f.*), who seems to have been the first to work methodically over the body. He borrowed the method from the astronomers who had observed in their studies of the acuteness of vision the least separation of two threads which appeared distinct. Goldscheider, applying much finer points, derived minimal values about 1/10 of Weber's, but showing approximately the same relative range of discrimination in the various regions.

as "one-point," "short line," "oval," "blurred area," "dumb-bell figure" and "two points." These results again suggest that there is nothing like a sensory threshold involved. In fact, the discussion about a "space sense" (*Raumsinn*), a "place sense" (*Ortsinn*), and a "consciousness of position" (*Lagebewusstsein*) rests upon the confusion of "consciousness" with the apprehensive functions.[10] The reference to the organism is more intimate in the exploration of the sensitive mosaic of the skin than in the distant object as seen by the eye or heard by the ear; but it stands no nearer (either in distance or in likeness) to the "processes" of sensation. We perceive places, forms, figures, distance, and localities upon the skin in the same sense as we visually perceive the like qualifications of physical objects.

It is true that touch, even the active touch which involves movement, is much poorer than vision in the apprehension of sizes, forms and shapes. That competitive game which calls for the manual identification of unknown objects concealed from view under a covering easily demonstrates the embarrassments of the dermal senses when unaided by sight. Where the eye distinguishes and identifies in a flash, the hand gropes and guesses. Still the ability of the blind to apprehend raised characters and figures with the finger tips suggests how far the tactual perceptions are educable. There the tactual discrimination of place, kinæsthesis from exploratory movements, and variation in intensity and extent of stimulus are all factors.

The Perception of Movements

The temptation to seek in "sensation" an explanation of the mysteries of experience appears again in the psychology

---

[10] The confusion appears in many writers, including Wundt, James, and Titchener. Ebbinghaus argues for the distinction; but he creates purely "mental acts" (Akten psychischen Erfassen, Lokalisationsakten) to bridge the gap between sensation and perception (*Grundzüge der Psychologie* (1913), Vol. II, pp. 188*ff*.).

of movement. Often writers have spoken of a "sensation of movement" and they have also based their descriptions upon that ambiguous phrase. But when we reflect that movement is usually a continuous modification of some spatial characteristic, we shall see that it is (at least in most cases) an aspect of apprehended objects—just as form, size, distance and place are.

Take any spatial aspect of objects that you please and consider it as undergoing a gradual and fairly rapid change. There you have movement. The toy balloon inflated by gas (size) or indented by the finger (shape) or cut loose and carried away (distance) or blown about by the wind (direction) or passed from hand to hand (place). All of these gradual changes we apprehend as movement. There is no more a "sensation of movement" than there is a "sensation of place" or of "distance." We apprehend it just as we apprehend the other spatial attributes and relationships of objects. It has, however, one peculiarity which relates it to melody, rhythm and speech—a class of non-spatial perceptions. It is an *event*. Movement goes on. It is in progress. Many objects we regard as static. Not so movement, which happens.

Now what are the conditions adequate to the perception of movement? The unreflective answer of common sense is "some object in motion." But a moment's scrutiny of a moving electric sign above the street will convince any one that this answer is wrong; or at least that motion in the stimulus is not necessary to the perception. A half dozen electric lamps set closely in a row and lighted in rapid succession will give rise to light "running along," and the movement will become still more continuous and fluent when the lights are inclosed behind a long ground-glass screen. The electric bird which flaps its wings, the electric arm which strikes, the electric fan which opens and closes above the theater, the electric mannikin which dances, are all light-

patterns which fade and glow in rapid succession. The objects do not themselves move. This creation of moving objects without change of place in the stimulus makes possible the moving picture, where the photographic film stops before the lantern-light, is projected on the screen, and passes on to give place to another, slightly different, momentary exposure. Another familiar experience which shows that the shift of objects along the skin or of light over the retina is not the real condition of the perception of movement is the passing of the hand over objects upon the table or the roving of the eyes over the landscape. In spite of the continuous shift in stimulation in these cases, the objects explored are apprehended as themselves at rest. But it is a curious fact that when the eyeball is displaced from the side by the finger tips or from the brain in dizziness (as after rotation), then objects are seen in motion although we "know" that they are standing still.

A good deal of mystery has been made of the perception of movement. Most psychologists virtually admit that the mystery is incrutable by declaring that the perception is native to the organism, that the individual is born with a capacity for apprehending movement; so they have recourse to a nativistic or genetic theory.[11] The fundamental fact underlying this perception is the wholeness of the perceptual field. It is continuous for any size and dimensions that we are able to apprehend. It is not a mosaic with empty interstices, as the dermal organs and the rods and cones are. The field of objects is *full,* so to say. A steady change in any spatial qualification is then a continuous change; and that is all that movement is. It may be that, in some animals, perhaps the annelid worms, the only spatial qualifications are three vague and discrete "therenesses," *i.e.*, "ahead," "left" and "right"; but with us the objects either crowd each other

[11] *Cf.* E. B. Titchener, *A Textbook of Psychology*, p. 357.

or are separated by "room"; there is one continuous "field" wherein all changes, that is to say movements, are, in a sense, equivalent.

One of the informing things about the conditions of movement is the lower limit. We do not ordinarily see the minute hand move upon the watch dial; though we may see it move upon the huge tower clock when we climb up and observe it from inside. We sometimes say that we feel the cheek swell under the congestion of toothache, and we can really feel the balloon move in our hands under inflation. What we really see in the first case is that the watch hand is at different places at different times; what we feel in the second is that the skin is more tense and the inflamed flesh more painful than it earlier was. There is then a minimal rate beyond which movement is not perceived. There is also a minimal distance upon the sensitive surface for the apprehension of movement. This distance is different in direct and indirect vision, being influenced by the rotation of the eye itself, and it is also different again for tactual perceptions on various parts of the body-surface. This minimal distance seems to bear some relation to the delicacy of discrimination for locality.

As in the other spatial determinations, so here the illusory or inadequate forms bring us first-rate aid in understanding the essential psychosomatic factors. We are all accustomed to the illusory misplacements of movement; the moving train beside our window which makes our own car appear to move, the backward and forward movements of the landscape as we fly past, the fleeting moon across the stationary clouds, the whirling of surrounding objects in dizziness and the floating movements of a small speck of light seen in a darkened space. Here the movement is read into the wrong object under a variety of conditions. Still more informing are those synthetic illusions of the successive lights and the moving pictures to which we have alluded. Here we have two fairly

distinct cases. In the first (the bare lights), the visual stimulus either moves along the retina or else tempts the eye to following movements. The illusion of movement arises provided the object observed is apprehended as one-and-the-same object in different places. If the lights flash slowly, so that we can count them as "one, two, three, four, separate lights," then, there is no apparent movement; but when they appear as "that light while there and there and there," then there is movement. It is obvious that any condition which tends to hold an object together in different places will favor the perception. The gradual tailing-off of the visual qualities and the after effects which are shown in the afterimages do just that. Psychologists have contended that it is the ligating effect of the positive afterimage which accounts for the perceived motion; but it has been shown experimentally that the perception may be obtained when extraneous filling takes the place of the afterimage or when the sequence is so slow that the afterimage dies out before the second stimulation begins. In these cases the persistence and continuity are guaranteed by some other means. The other means may be central and take the form of a predisposition or set to identify the object in spite of its translocation. If the conditions make it appear likely that one and the same object may pass from place to place, the observer is disposed to perceive the separate exposures as phases of movement. In the ordinary moving picture, the same area of the retina—usually the fovea—is stimulated over and over by slightly different patterns. If these patterns give rise to consonant views, *i.e.,* views which *might be* views of one and the same object, then the movement perception is likely to arise. The comic animated creations upon the screen, which may be integrated from a few, widely different drawings, show us how far an habituated attitude favoring movement will go upon slender materials. The approximate upper and lower limits of temporal succession in the stroboscopic sequence are 0.5 seconds and 0.05 seconds.

If the succession comes more rapidly than 0.05 seconds then there is successive light mixture and the result is a blur, as in the rapid rotation of the spokes of a wheel; if the rate of succession is slower than 0.5 seconds then movement perception usually disintegrates. It is, however, possible to retain the perception of movement even when "blank" intervals are plainly visible, with a sequence of exposures as slow as 6.0 seconds. But in this case, which may be produced by passing simple objects through a tunnel, the moving object is apprehended as alternately appearing and disappearing. Within the last decade experiment has thrown new light upon the visual apprehension of movement. When two narrow strips of gray or color are set one above the other $\left\{\begin{matrix} a\text{———————} \\ b\text{———————} \end{matrix}\right\}$ and exposed in succession at a certain rapid rate (.06-.09 seconds) movement may appear. Where *a* is first exposed, then *b*, *a* may move down toward, or to, *b*. When the rate is increased, movement disappears and *ab* is given together in time, as two neighboring strips; when it is decreased, then *a* appears and *b* simply follows it, again without movement. But a still more significant phenomenal movement sometimes appears at the middle or "optimal" rate of exposure. The observers then report that the middle region (between *a* and *b*) is the scene of an independent movement which is unrelated to the lines; a bare moving flash which suggests the catless grin in the tree. Further experiments have shown that movement may also be produced without retinal displacement. This extraordinary fact is illustrated by observing in succession the central stalk of the Müller-Lyer figure in its two forms (Fig. 27). Thus *a* is momentarily exposed, then *b* in the same place. When the vertical lines are of the same objective length, the single perceived line appears to grow or expand in the temporal order *ab* and to contract in the reversed order *ba*. This "movement" accords with the illusory effect of the

accessory lines, *i.e.*, the "open" form appears longer than the "closed" (*cf.* Fig. 27).

Wertheimer, who first performed the experiments with the displaced parallel strips, concluded that the bare "objectless" movement (which he called the phi-movement) was an ultimate moment in visual experience to be explained by "short-circuiting" within the central nervous system.[12] That observation of movement under these conditions rests upon the "perceptive attitude" of Wertheimer's observers is the contention of the Cornell Laboratory, where the Wertheimer experiments were repeated. There the perceptive attitude confirmed the former descriptions of the phi-movement; but observations made under the "qualitative" attitude reported instead of movement a "gray flash." Here the instructions under which the observer reported were certainly better controlled than before; and it is of interest to know that the movement perception may be dissolved by an attitude of observation which is dependent upon cerebral conditions. The two different results suggest the illusions of reversible perspective in which a constant visual pattern of lines may be perceived as one figure or another according to the self-instruction (or central set) under which the object is viewed. Another instance is the ambiguous perception of Figure 30,

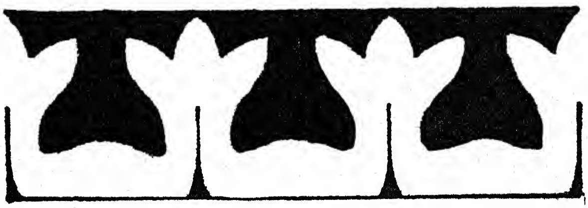


FIG. 30. AMBIGUOUS PATTERNS

From K. Koffka, *Psychological Bulletin*, 1922.

[12] The experiments of Wertheimer have inspired much of the work done in the last half-dozen years in support of the *Gestalt* theory (*cf.* pp. 115-17).

which may be seen either as three black *T's* set upon a white ground or as a decorative white leaf-border.

Whether the qualitative attitude of the Cornell study is more ultimate or more representative of "bare experience" is to be questioned. At all events the whole series of researches suggests new conditions for the apprehension of movement. Under Wertheimer's conditions movement appears to be one of the "abstractive" perceptions, similar to the perception of bare height or breadth in the open sky and to the mere lapse of time, where the qualitative "filling" is of small moment to the apprehension.[13]

The Perception of Materials and of Work

It would be a mistake to suppose that all our perceptual meanings are spatial. While in our direct apprehension of the outside world objects seem to have been run into a spatial mold, a good deal of the perceptual meaning is related to the spatial forms only indirectly or by accident. We apprehend a book as made of paper leaves and cardboard covers just as directly as we see it to be rectangular or oblong, the ring as of dull, lustrous gold and sparkling diamond as well as circular and thin. The solidity and whiteness are aspects of the perceived building just as length and height are. The locomotive engine is a vehicle bursting with energy and capable of accomplishing prodigious tasks. The tree is a growing, resisting thing which sustains its branches and leaves and holds commerce with the forces of nature. As before, our primary task is to describe the factors, physical, organic and mental, which enter into this type of apprehensive function.

[13] The chief experimental titles for the phi-movement are M. Wertheimer, *Zeitschrift für Psychologie* (1912), Vol. LXI, pp. 161-265; F. Kenkel, *ibid.* (1913), Vol. LXVII, pp. 358-449; F. L. Dimmick, *American Journal of Psychology* (1920), Vol. XXXI, 317-332, and K. Koffka, *British Journal of Psychology General Section,* (1924), Vol. XIV, pp. 269-273.

Since we cannot look into or tactually explore the contents of most solid objects and since we cannot directly see or hear or touch the forces resident in active objects, it is natural to say that we "infer" these material and dynamic qualities. Natural, but not correct. These perceptions are just as direct and immediate as the apprehension of size and shape. They are generally mediated in one of three ways; by imaginal completion, by kinæsthetic supplements, or by the immediate extension of meaning. Consider the three cases.

When dealing with the mixed incorporations we found that sensimaginal qualities were present, as in the cold smooth ice seen to fall in the street and the soft velvet hangings seen across the room. This is the first form of mediation. The materials, physiological and mental, immediately provided by the stimulus are supplemented from central sources, and the supplements help to supply the meaning. In the second case, incipient or mimetic movements are the chief resource in the apprehension of materials and energy. The late Theodor Lipps of Munich constructed an entire æsthetics of space upon the contention that we read into objects and even into outline figures the forces and counterforces which we kinæsthetically apprehend in our own bodies. So the supporting pillar pulls itself up to meet the load of the entablature, the tree braces and exerts itself, the long horizontal line tends to sag under the force of gravity, and so on. The creation of perceptual meaning by exertion is undeniable. Every automobile driver knows the fatiguing strain of helping his engine up a difficult grade and every golf player the unpremediated attempt to guide the ball by strains and twists after it has left the face of the club.

As we have already seen, the kinæsthetic aids are not to be assumed in all perceptions; but they are undoubtedly a common resource of the organism, especially in the apprehension of material and dynamic qualities. We found, nevertheless, factual substantiation for the third case, the case

where extensions of meaning accrue to the primary qualities at the core of the perception. We do at times literally see softness and weight and yieldingness and sharpness. While it is probable that those aspects of the world which we regard as tactual or kinæsthetic were originally mediated by these senses, short cuts and other economies of the organism are constantly simplifying the means employed. Where we find in the body what the physiologist calls the "conditioned reflex" we find in experience accessory and incidental factors assuming the meaning which previously attached to more elaborate formations. Thus it comes about that visual qualities can mean "coldness" as well as the thermal qualities themselves; tonal factors mean "a small tingling object" or "a powerful, thundering dynamo"; a bitter taste "noxious food," and so on; mental factors assuming, through occasion and use, functional aptitudes which we generally regard as beyond their reach.

The Perception of Sound-Objects

As we have seen, the apprehension of objects and events as present does not necessarily imply that our perceptual meanings are geometrical. We have just considered instances in which spatial meanings are at most implied. Now we proceed to objects which are actually non-spatial. They have neither place, shape nor distance. A melody or a rhythm is, nevertheless, as much of an object as a box or a tree or an express train. Its meaning does not include spatial peculiarities. That is the difference. A melody has neither size, linear diameter nor height. Like movement it is an event; but an event which does not involve change of place. So too rhythm. So too the combination of vocal sounds in the sentence. These are spaceless objects. What are the factors necessary to their apprehension?

In rhythm the stimulus is usually an ordered series of vibratory movements recurring with fixed temporal relations.

Thus the regular "click" of the metronome furnishes the auditory stimulus to a simple rhythm. The stimulus is, at least in most auditory rhythms, usually augmented by pull of tendon and contraction of muscle, which supplement the auditory component. The tapping of the feet or the finger or the nod of the head in time with the sound may be taken as typical. Even when these overt movements are not observable, careful scrutiny will often find contractions of the muscles controlling the drum-skin of the ear, or modifications of breathing, or a pull upon the vocal cords, or minute inclinations of the head, or abdominal twitches. These "following" movements seem to hold the rhythm-object together and to direct its meaning. At times the auditory factor is wholly wanting, tactual and tendinous factors replacing it, as in a light tapping with the finger or a beating of the air with the hand and arm. The essential thing, on the side of stimulus, is a regular repetition. As regards mental qualities, the basis for rhythm lies in the temporal ligation which was described under the primary incorporations. Two or more qualities with unlike temporal coefficients are bound together in the rhythmic unit and this unit is repeated time after time with slight variations. As thus bound together, each member has its individual place in the unit and each unit has its place in the larger complex, *e.g.*, the line or verse. Variety in rhythm-objects is as wide as the musical and metrical forms to be found in any given culture. As rhythmization is highly educable and subject to modification without change of stimulus, it appears that central sets and dispositions play a large part in its interpretation. Central participation is easily demonstrated by the premeditated shift from one rhythmic form to another with an even succession of simple tones or noises. A pure visual rhythm seems to be obtainable only under high practice and experimental control, because of the fixed tendency of kinæsthesis to "follow" visual stimuli of regular recurrence.

Melody is closely related to rhythm. On the side of stimulus it adds fixed relations of vibrational rate, and, on the side of experience, intervals (*i.e.*, measured tonal distances) and a fixed basis or keynote about which, above and below, the melody swings. As a rule, the melody begins and ends with its basal note. Progression, then, in melody is similar to "getting on" in movement. The melody advances by "moving" through fixed tonal distances which lie on either side of its base-line. Its object has greater significance than the rhythm-object, which it contains, so to say, within it. It would appear to be possible to construct a rudimentary melody by a progression of tonal intervals set together without measure and devoid of accent; but certainly melody as we commonly know it implies the regular recurrence of the rhythmic unit. When we add to the rhythmic progression of the simple melody the chords and the clangs, those tonal objects which are apprehended by means of simultaneous fusions or qualitative incorporations, we have at hand the principal resources of music, *i.e.*, we have those fundamental perceptions which when integrated in large masses are the sonatas, dances, oratorios, symphonies and other spaceless objects of music.

The Perception of the Body and of Its States and Conditions

In our common speech the word "self" is used with various connotations. Sometimes we mean by the "self" the individual who carries a name, fills a given place in the family, meets engagements, poses and postures in photographs, and otherwise occupies an unique and individual place in the "family-social" world. Sometimes we mean the author of "our" thoughts, the instigator and governor of "our" acts, and the bearer of "our" emotions; this self is supposed to think, will and feel; to be the activity behind our performances. We might call it the "spiritual self." Again we mean

by "self" the body and its activities *plus* the mind. This is a more sophisticated notion. We derive our knowledge of this self from anatomy, physiology, psychology and other scientific observations. We may speak here of the "psychophysical" self. In still another way we apprehend the self in direct and immediate perception as a present object to be found among other objects. It is the perception of this directly apprehended self that we here consider among the psychosomatic functions.

First of all, there is no doubt that vision plays a large part in this apprehension. The late Dr. Ernst Mach, eminent in physics, sense physiology and psychology, has drawn a picture of his visual self, as this object appears when viewed by the left eye alone. In the immediate foreground is the lofty dome of the eyebrow with the bridge of the nose showing at the right. Then the trunk; and beyond it the legs and feet. As thus drawn the bodily self has a curious detachment and objectivity. So have the views that we get in the mirror, in photographs and in portrait paintings. These stand of course among thousands of "views" that we get of the self every day; and they are further supplemented by tactual explorations, by turning the head, folding the hands, supporting and rubbing against the clothing, sitting, leaning, and standing. Besides the visual and tactual resources for this perception, stand the kinæsthetic. Every movement, every posture, every change of position calls into existence a complex which means "here am I," or "I stretch my arms," "I support an object," "I stand rigid on my feet," "I bend," "I whirl," and so on and on. Frequently this bodily self is just taken for granted, the meaning for the moment being confined to other objects or to thinking and planning; but many times during the day this bodily self does emerge either as a part of the perceptual scenery or as an unique object regarded in its own behalf. Still we have not touched upon those factors in this apprehension which chiefly make

the self intimate and peculiar. These resources are the visceral organs and processes and the somæsthetic qualities which rise from their varied functions. During the day the visceral processes complete a cycle whose phases are marked by fairly regular alterations in the vague obscure mass of bodily "feeling." Upon awaking the elastic feel of health and vigor, the unpleasant pressure from the distended bladder, the vague ache of hunger (changing into pain, general lassitude and weakness if the accustomed breakfast is long delayed), the comfort or discomfort of digestion, the gradual shifts in visceral well-being or ill-being which appear in the succession of moods, the further alternations of hunger and repletion, the general relaxation of the evening, the partial somatic anæsthesia of approaching sleep in which the bodily self of perception is apt totally to lapse, and the curious and bizarre translocations of organic processes in the dream, bring the organism around again to the beginning of a new cycle.[14] Here the vital and indicatory aspects of experience play an important rôle.

A peculiar and striking apprehension of the body appears when we lose our balance, as in rapid rotation or the sudden rise from a stooping position. When the loss of equilibrium is accompanied by an apparent whirling of objects around about and a general unsteadiness of gait and posture we speak of dizziness or giddiness. It was for a long time thought that a specific dizziness quality arose from the stimulation of the disturbed semicircular canals; but such a quality has not been verified by careful inspection. We know that the semicircular canals are set into function in these cases, that they are intimately connected by nerve fibers with the cere-

[14] Not always—as we all know—do the factors due to visceral function and change contribute their important share to the apprehending of the bodily self. Often they enter into and give coloring to fear, anger, joy, rage, and the like. To these matters we return in the section devoted to emotion.

bellum and other central regions controlling movement, posture and visceral function. We can understand, then, how almost the entire organism may be affected by whirling movements, as well as by disorder in the vestibular region of the ear; and how, therefore, the perception of the bodily self and of its condition of equilibrium may be profoundly affected. The perceived loss of bodily equilibrium is due in part to the general absence of control of those muscles which determine posture and position, in part to involuntary twitching movements of the eye which make the world whirl around, and again in part to the visceral disturbances of nausea which give a strange and uncomfortable coloring to the perceived state of the trunk. That sensimaginal factors and central trends may also be involved in these perceptions of disturbed equilibrium is shown both by the effect of "suggestion" upon seasickness and by the experimental demonstration that the perception may be removed by carefully controlled rotation of the body.

Abstractive Perceptions

In the perceptions which we have here discussed we have spoken of the "object" or the "event" as if a total and concrete bit of existence were involved in the meaning. As a matter of fact, we never exhaust an object by an apprehensive function. We always abstract this or that aspect for consideration. The meaning is always partial or one-sided. In so far all perceptions are abstractions. Nevertheless, in most of the perceptions which we have considered, an object is implicit in the meaning. When I perceive the top of the writing table to be about three feet by five feet, it is the table that has those dimensions. I do not simply perceive a ratio 3:5. So with the other perceptions. But we do at times leave the total object in the background and actually regard as present some phantom or ghost, as in the phi-movement above, instead of the "real" flesh-and-blood object.

We do, after a fashion, perceive the grin without the cat. Let us examine typical cases.

An instance is to be found in the perception of duration. When we sit, hat or gloves in hand, in an outer office waiting to be called for an interview or for our turn with the dentist, we are likely to apprehend the passage of time. This apprehension is not the same as that of the temporal persistence of an object. Time is an event which is going rapidly or slowly. It is a going-on, and a going-on that is different from such durational objects as melody or rhythm. We apprehend this going-on in various ways. Our psychosomatic resources are fairly rich. Inspective observation distinguishes the durational aspect of every mental quality—sheer durativeness or protensity—from the apprehension of the temporal relations of events, an apprehension which is similar to the perception of extents in space and of the advance of objects in movement. The author observed in a passive state of absorption the even flow of fine sand falling past a weakly illuminated opening in a lightless field. The visual flow was accompanied by a low, monotonous swishing noise from the sand. Under instruction to give himself up to whatever came, he observed in a fairly simple form the apprehension of temporal progress. The "getting-on" meaning attached itself, under these experimental conditions, to the visual-auditory qualities. Gentle respiratory movements and eye movements, together with the accompanying kinæsthesis, may be used under favorable conditions to the same end. A temporal sequence may be apprehended with clear auditory qualities where the stimuli are separated by as little as 0.002 seconds and down to 0.044 seconds with succeeding flashes presented to the eye. A more complicated apprehension of time has been studied in the experiments on the "time sense," where short intervals limited by clicks or flashes were compared to determine which was the longer. It was found that in very short intervals (up to 0.6 seconds) the limiting clicks or

flashes were taken together as click-click or flash-flash. These very short times seem hurried and produce discomfort. The total impression was judged, rather than a temporal gap separating the limiting events; intermediate times (0.6-5.0 seconds), on the contrary, are apprehended by way of their filling—chiefly tendinous strain; and larger intervals (5.0 seconds and above) are compared by means of secondary criteria. Here the number of mental items running their course, the degree of fatigue, the tension and relaxation of expectation and fulfillment, shifts in mood, and changes outside the organism, all may be used as a basis of apprehension. Not much is known about the perception of times several minutes in length, but some unpublished experiments by the writer lead him to believe that certain unknown physiological processes may immediately touch off the verbal "two minutes," "five minutes," "it's over" and so on. An astounding degree of accuracy for intervals as long as fifteen minutes appeared without any warning that the observer was "getting on" toward the end of the interval. Some such physiological alarum clock may be responsible for the arousal from sleep at a predetermined time. It seems to be required in the case of one of our observers who had an average deviation of less than five minutes for a long series of predetermined arousals from sleep throughout the night. As the waking time was changed each night, we cannot suppose that an habitual set for a given time was gradually established by repetition.

Generalized Objects

A new and striking animal when first seen in the zoölogical gardens is apprehended less as an individual than as the representative of a class. "So *that*"—we exclaim—"is a giraffe!" "At last a coati!" "Oh! this is the way the hippopotamus looks!" The new creature has no personalizing marks. He is a new "*that*"; a specimen or type. White men often observe that all strange yellow men or black men look alike.

That is because the rare specimens of an unknown race are just black men or yellow men. The entire meaning of the object is the generalized apprehension which identifies the specimen. No individualizing marks appear. Compare with the perception of one's own family or of a close associate in business. The tendency to generalize may be based upon a foolish racial prejudice or upon ignorance; but the ability to see only the general or the typical is of very great importance to the apprehensive functions. It takes us beyond the individual case in the direction of generalization. Generalization is by no means confined to thinking, as we are prone to believe. For in our perceptual intercourse with present objects and events also we learn to neglect the "thisness," the individualizing meaning, and to consider the object or event merely as a representative of its kind.

The collector and the taxonomist in science know the value of this generalizing tendency. The stamp or coin or bird's egg is nothing as an individual; it is everything as a representative of an era or dynasty or variety. The systematic biologist learns all the marks of the species, genus, family and class, that he may put every specimen into its place among the forms of life. We all do the same with objects used as values and counters. The silver quarter and the five-dollar bill are nothing as metal and paper, as die and ink; their whole nature consists in the amounts which they represent, valued in terms of goods which we may wish to possess. The limit of our generalizing abstraction in perception is reached in the mathematical treatment of figures and groups. The Euclidian geometer works with lines, surfaces, and solids. He derives and verifies his theorems by drawing figures and reasoning about them. His demonstration of the area of a given pentahedron or of the sum of the angles in a triangle does not apply to the figure in chalk upon the board. What he apprehends and what he bases his demonstration upon is a spatial figure of certain properties but

without the "filling" of blackboard or wood or metal. The blackboard space is not his space, the wooden cube is not his cube. His objects are space objects without place, without time and without material substance. They are mathematical objects; as real as stones and trees and plants, but belonging to a different order.

CHAPTER X

THE MODES OF APPREHENSION: II. MEMORY

The Distinction between Memory and Learning

In our common thinking, where the main aim is to give a reasonable account of the plain facts of experience, we make short work of the problem of memory. We begin by saying that in memory we "revive" or "bring up" or "reproduce" the past; terms which suggest that our experiences are somehow conserved and reincarnated. When pressed for further information we add that the conserver is just "memory"—a capacity to harbor, store, or safeguard those events which we live through and to bring them forth upon appropriate occasions as memorial repetitions. This account does serve our practical purposes; but it will not bear the scrutiny of the psychologist, who will tell us that we have been speaking in loose, picturesque and figurative terms; that we have at once made "memory" a store house and the things stored, at once a resuscitator and the things revived, a reproducer and the things reproduced. Hardly a substantial and consistent account! How can we improve it?

In the first place, we must agree to regard memory as a kind of performance or accomplishment. We do remember; that is the plain fact. In the second place, we shall seek to define this kind of performance as an apprehension of objects and events as falling in our past individual experience. So we shall set it alongside the perceptual type of apprehension. In the third place, we shall seek to find the concrete conditions under which we memorially apprehend.

Memory is quite different from "learning." To learn

first suggests an acquisitive function. To learn a poem is to acquire the ability to recite it without the text. To learn a language is to go through the operations necessary to the free and intelligible use of a system of verbal symbols. Neither in the learning nor in the exposition of the thing learned is a memorial reference necessary; although the memorial functions may—it is true—coöperate with others. As a matter of fact, that which we "learn" best and most permanently bears no past date. When we recite a poem perfectly learned or seek to discover the exact phraseology to express a thought, there is, as a rule, no explicit reference to that time when we repeated the poem or when we acquired the appropriate words. As I recite a scene from Scott's *Lady of the Lake* or a poem by Richard Lovelace, no explicit reference to my own past appears. Whatever "pastness" attaches to the recital concerns the time in which the scene was laid or the stanza written—not a real memory, because I was not then living. To apprehend something as belonging to my past is very different from using the past experiences of the organism as a means to a present recital or as an acquirement which aids thinking, perceiving, or acting. We say that we learn how to think effectively or to act skillfully or to observe with care, and so the past with its labors and successes is *logically* implied; but this is wholly unlike the particular form of apprehension with which we are here concerned. For the present time we treat only the apprehensive function of memory and leave learning for another occasion.[1] This means that we shall omit for the

[1] It is unfortunate that the word "memory" has been used indiscriminately in these two senses. As a principle of functional conservation at large memory has acquired a still wider connotation, implying organic change under use. (*Cf.* E. Hering, *Ueber das Gedächtnis als eine Funktion der organischen Materie* (1876); R. Semon, *Das Mneme,* etc. (1908), 2nd ed. Most of the literature labeled "memory" and "association" falls under "learning" or "organization." Ebbinghaus, who wrote the first experimental monograph on memory,

present a very large literature that is frequently brought under memory, but which really relates to the conditions of acquisition and of "improved" performance.

Memory and Perception

Regarded as a performance or operation of the organism, memory is much like perception. The experiential factors are integrated in similar patterns, and similar bodily structures and processes are brought into requisition. It is mode and outcome that are different. In perception the object or event is apprehended as present; in memory as past. How is this difference to be accounted for?

Well, in the first place, the factors involved, though similar, are not, as a rule, the same. A memory implies sensimaginal resources more than sensational; the body at large is less involved, and the cortical part of the cerebrum more. The total image, which is usually the smallest unit of cognitive reference in memory and in imagination, is organized under central conditions; and the trains and sequences of images are also centrally controlled. In the second place, the temporal reference in the memory is, to be sure, to the past; but it is—as perception is—a reference to one's own experience. In reading *A Tale of Two Cities,* I may picture a scene at the Defarges'; but this scene, though past, is not *my* memory. In really *memorial* events, the individual participates as he participates in the present parade or the present dinner party. He is "at hand," paradoxically enough; at hand *then,* not *now.* A memory, in fact, seems to be "mine" more than perception; probably because it depends solely upon my organism and so is not "shared" by others. The

---

Ueber das Gedächtnis; Untersuchungen zur experimentellen Psycologie (Leipzig, 1885), explains in his preface that he uses the term to include impression, retention, association, and the reproduction of ideas. Along with most of the researches which it inspired, this classical work of Ebbinghaus is really a study of the conditions of learning or acquisition.

outside world contributes its part to the perception but little or nothing (at the moment) to the memory. This difference is often taken to mean that the memory is a "mental object" whereas the perception is a "physical object." This interpretation is wrong. The stamp window at the post office is, as I recall it, no more a mental window than is the same place when I actually stand before it and pay for postage. Both are known objects; both depend, at least so far as my knowledge of them is concerned, upon coöperative functions. One is the window as I stood before it yesterday; the other is this present window where I am laying down my money. It is the setting, then, that is different, both the context in which the mental structure is set and also the context of meaning.

If we leave aside the perceptions of the dream, which are drawn in large measure from sensimaginal sources, and the emotional and mimetic memories of stirring events which are largely dependent upon organic and kinæsthetic factors, we may consider memories as primarily distinguished by sensimaginal processes. Their core, at least, is imaginal. It follows, therefore, that the extent and completeness of memorial meaning principally rest upon the conditions which supply adequate sensimages and organize them in appropriate ways.

To understand the conditions under which we apprehend in the memorial or backward-referring way, we must return to perception; for the character, the fidelity, and the extent of memory ultimately rest in large part upon this antecedent function. It is probable that all the original conditions which influence the integration of the perception affect the memory. Experimental evidence bears out our general experience that vivid and coherent perceptions lead up to—other conditions remaining the same—the most vivid, precise and faithful memories.

There is one curious anomaly in memory which seems to stand against this rule. We might expect that the oftener

a perception was repeated the clearer and more faithful would the memory appear. This is not true; at least not universally true. If you will examine your most vivid and most accurately localized memories, you will find that they usually refer to single and unrepeated perceptions. The absent lover is recalled as he stood at such and such a moment and on such and such a spot uttering such and such a thrilling declaration. An unduplicated experience! A memory to be photographic requires one favorable impression. The reason seems to be that it must be temporally localized, and as soon as it refers to two or more preceding occasions it begins to be ambiguous in its reference. Like composite portraiture it acquires a haze of indistinctness. The common observation that it is difficult to recall with accuracy the features of an intimate acquaintance suggests the explanation that many views with many expressions and many plays of features have commingled to produce a total image of shifting detail and uncertain reference. So Tennyson's complaint in *In Memoriam:*

> I cannot see the features right,
> When on the gloom I strive to paint
> The face I know; the hues are faint
> And mix with hollow masks of night.

Parting friends cherish a vivid last glance hoping that that will remain clear-cut and faithful, to be preserved by frequent memorial revivals in spite of time.

It is, to be sure, incorrect to regard memory as a "copy" of a perception. In strictness, we cannot say that any experience is "reproduced" or "revived." What is revived is the meaning. At this moment I see the hills as the fog half hid the eucalyptus trees in my walk of yesterday. The hill-fog-tree meaning is almost the same as it was yesterday; although it is now mediated by a new set of mental factors and also by a body that is, to some extent, changed. Because

it is the same scene, we set up the fiction that it has somehow been stored away in brain cells and so preserved as a memory to delight us in reminiscence. There are two extraordinary things about memory; first, that the body should be so impressionable and yet so tenacious of its impressions as to be capable of repeating a complicated function in the absence of the original outside conditions; and, secondly, that meaning should be so delicately attuned to factors organized first under outside conditions and then under central conditions alone that the same experience (*e.g.*, the hill-fog-tree experience) should be created upon both occasions.

The Backward Reference in Memories

We must not confuse "recognition" with a "dated pastness." Both are aspects of meaning. In recognition, whether the object is perceived or remembered, the meaning is "I know you" or "the thing is known." I recognize the delivery wagon of my grocer when I see it flying around the corner on two wheels; I recognize the letter that I remember to have received from my bank. It is "that letter." Along with the other meanings of the remembered object goes this meaning of being familiar. Again, and quite differently, stands the meaning that this remembered object comes from my experience of yesterday, or of Labor Day or Christmas, or that this thing happened on my twenty-first birthday. The remembered thing must be familiar, else it could not be referred to my experience; but is must also bear a memorial dating which is a different kind of meaning. Now the conditions of the familiar meaning are various. An associative connection may bring a name or other descriptive epithet; an attendant circumstance either from stimulus (in perception) or from associative tendency may supply context; or the perceptual or associative train may fit the object into its larger setting—as the street which one recognizes because one is searching in a well known part of the city.

In all these ways the context, running along with those qualities which primarily carry the object's meaning, verifies the object and accounts for its familiarity. These are usually cases of *indirect* recognition. Besides them there is the *direct* kind wherein the primary or secondary incorporation itself carries the familiarity, as when we identify an article on the counter as "the very one I saw last week" or, a particular colored paper in a laboratory series is immediately recognized as "the one exhibited yesterday." Here nothing can be set down in terms of quality to account for the recognition, unless it be the promptness and the clearness of the perception. It looks as if promptness and clearness might themselves carry the added meaning "familiar." For the rest, we shall have to guess at such suggested but obscurely known bodily conditions as reduced synaptic resistence, an incipient spread of excitation (Külpe) or a peculiar kind of molecular change in the brain (Höffding).

Psychologists have been at pains to find some peculiar and unique factor in memory to account for its "memorial" stamp, for the fact that the memory fits into an appropriate past context. Several of them have pointed—as we think wrongly—to the recognition of the remembered object, to the fact that it appears familiar. Höffding, a Danish psychologist, thought that recognition depended upon an unique "mental process" which he called the "quality of knownness" or of "familiarity" (*Bekanntheitsqualität*). Wundt called it a "feeling of recognition" which was for him compounded from the "feel" of the original perception *plus* a relaxation-feeling (*Lösungsgefühl*). Titchener takes an intermediate position, translating Wundt's *Lösungsgefühl* into a "sense feeling" of the agreeable and relaxing type, diffusely organic in its sensory character. This is for him the "feeling of familiarity." It accounts, as he thinks, for the recognitory function of the memorial idea. Both Höffding and Wundt propose an unique "mental process" which has not been

identified by inspection. Titchener ventures to guess that his sense feeling is "a weakened survival of the emotion of relief" which primitive man may have experienced in the presence of accustomed objects; an emotion which stood in contrast to the unpleasant apprehensiveness experienced before the strange and the unknown. Titchener's account, which tends to make Höffding and Wundt a little more empirical, has two defects: (1) it does not explain why our extremely common surroundings, which are taken-for-granted in direct apprehension ("cognized," in Wundt's terms), are as far as possible removed from strangeness, although the affective tone has died out of their perception; and (2) it does not fit well into the whole mass of memories which are not uniformly of the "agreeable and relaxing" type and nevertheless are recognized, *i.e.,* stamped and dated in the past. Other explanations of the recognitive character have referred it to the degree of attention (Heymans), to a process of comparison of new and old ideas (the associationists), and to the "consciousness of self" (Dürr).

As for the other meaning, the "pastness" written across the object or occurrence, we can frequently find by inspection that the dating is due to the context, *e.g.,* adverting to my breakfast of this morning the sugar bowl is the bowl of that instant when I selected the lump for my coffee. Without this context the sugar bowl, which is always on the breakfast table, might simply be "that dish," a familiar object without pastness or at least without any particular pastness. At other times, the dating seems to be inherent in the combination of sensimaginal factors which make up the image. Instants from the past flash up as we imaginally regard a close acquaintance. The dating here seems to rest upon the particularity of the incorporation. We see *A* as standing so-and-so with such-and-such a whimsical expression or uttering a characteristic exclamation. Here we may be pretty sure that the past meaning is carried by a total mental struc-

ture and the central processes which accompany it. As outside aids we should not overlook the efficacy of the remembered bodily postures, somatic states and mimetic movements. I drop my jaw, throw back my head and gaze, and suddenly appears in memory the Tower of Jewels as I first saw it at the Exposition of 1915; I square myself for boxing and in a flash I am in an excited audience witnessing a memorable bout; when I frown meditatively a former instructor in philosophy appears as he looked in his study the first day that I began to read with him Kuno Fischer's *Des Cartes und seine Schule*. More of our dated memories than we know derive their temporal meaning from just such bodily reinstatements as these.

Conditions of the Memorial Functions

Our experimental knowledge of many of the conditions of memory (*e.g.*, the amount perceived, the organization of the primary incorporation, the perceptual constellation and train; sensory clearness, context, intent to remember, practice, fatigue and so on) is still imperfect; but it is certain that all these matters do affect both the fidelity of memory and the rate and amount of true memorial recall. We know quite definitely that time affects the memory both by way of transformation and by way of decay and disintegration. The experiments of Philippe have demonstrated the tendency for the specific memory to be transformed in the direction of a stock type, *i.e.*, of some neutral and undated acquisition which, because of its fixity, is more useful than the particularized memory. A similar change in memories is commonly induced by verbal description. When an acquaintance strikes us as "tall" or as "homely" or as "awkward," our declining memories of him are likely to be changed to conform to the stock "tall" or "homely" or "awkward" man. A part of our surprise upon noting that a long absent acquaintance is not exactly as we had remembered him is due to the application

of these verbal epithets which are apt to fit too loosely the individual case. Again, there is some evidence that our simpler memories at least (as of colors and of grays) suffer modification through similar perceptual experiences subsequent to their "registration." If that is true, then a remembered medium gray surface would tend to grow lighter when the memory-interval was filled with light-gray perceptions and darker when filled with dark-gray perceptions. The wonder is that the bodily residues of perception, being various and multitudinous, do not constantly cross and commingle and so cancel all possibility of the dated and individualized memory.

Finally, the appearance of any memorial function is dependent upon appropriate conditions at the time of recall. Some men have maintained that there are spontaneous memories; that memories come of their own initiative without waiting for favorable conditions. Herbart believed that ideas were forces which tended to thrust themselves into existence and were only barred from "consciousness" by counter and inhibiting forces keeping them down. Fouillée, the French moralist, later wrote a psychology of *idées forces*,[2] and this doctrine has recently been revived in a modified form as "perseveration," a term which stands for a periodic strengthening of cerebral or mental residues, called "perseverative tendencies." These tendencies have been supposed to bring imaginal processes spontaneously into existence, and so, under favorable circumstances, to lead to memory. No one of these forms of spontaneous memories is sufficiently supported by empirical evidence to be credible. It is likely that the initiation of the memorial functions always needs a push; always needs some favoring circumstances within the central nervous system to set it going. Once started, however, it may command in its own right energy

[2] A. Fouillée, *La psychologie des idées forces* (1893), 2 vols.

(on the bodily side) and meaning (on the mental side) to carry it through.

Memory and Psychoanalysis

Capital is made of the individual localized memory in the clinical method of psychoanalysis. This method rests upon the doctrine that the residues of certain experiences remain as "unconscious" memories to afflict the individual and to induce mental and bodily disorders. The method consists of an attempt to assist the memorial psychosomatic functions, *i.e.*, to "bring to consciousness" (in the phrase of the psychoanalyst) the repressed "unconscious" memories. The practice of the method generally rests upon the belief that these functions, when induced, remove the disorder and so relieve the patient. To explain the curative effects of the exercise of these functions, the psychoanalysts have elaborated a theory of "consciousness" which makes it the seat of contending and conflicting forces, one of which is personified as the censor who presides over the "unconscious" and prevents repressed ideas from becoming "conscious"; prevents (in our terms) the carrying through of the memorial forms of the apprehensive functions. We must suppose that, in some cases, it blocks also the perceptual functions, as in the case of hysterical blindness and deafness, as well as the normal execution of acts, in impulsions, paralyses and automatisms.

Now it is of course possible to observe such striking facts as we have alluded to without accepting the intricate and highly speculative explanations in terms of unconsciousness, repression, the censor, and the like. Since we have not until now found it necessary to assume a separate and independent mental government, a dynamical agent, a set of contending powers, and a sea of unconsciousness, it may be better to remain close to the facts and to be content, for the time being, with more modest descriptions and explanations.

The psychologist has for a long time known that perception, and especially perception in an emotional setting, might leave upon the body a lasting effect. And it is more than thirty years since Breuer and Freud and some of the French physicians found, as they thought, that hysteria and allied disorders were to be traced to early, frequently adolescent, experiences of a painful and disturbing character. The troubles had in some cases remained latent for years. A scar or "trauma" had been left upon the organism. Reviving the ancient doctrine that memory is a storehouse and observing that the patient could not, without aid, reinstate the distressing experience, these men concluded that the memory was "repressed" and retained in the "unconscious." We might of course say that every bit of psychosomatic function of the memorial kind which is not at the moment being carried through abides in a hypothetical "unconscious" or "subconscious"; but this would tell us no more than that, at the moment, the appropriate conditions for setting off these functions were not at hand. We might indeed carry the doctrine of the unconscious into new territory and say that the perceptions of to-morrow and of next week are in the unconscious. The only difference is that some of the conditions essential to unrealized perceptions lie outside the body whereas the conditions for memory are thought of as somehow attached to the organism or as carried by a permament mind or "self."

Bodily residues, more or less permanent, do certainly outlive the temporary functions of the nervous system. The nature of them we do not know; though we speak of them as "functional dispositions," "traces," "impressions," "engrams" and the like. It is obvious that these dispositions, or this liability to functionate in a certain way, may be of a highly complicated pattern. It may be that, along with the disposition, "mental processes" continue to exist, unobservable under the conditions; but we have no positive evidence that they do

so continue. We do know, however, that the disposition may, under appropriate circumstances, lead to a memorial function whose meaning is "that event in my history." It also appears —and for this information we have to thank the psychoanalysts—that the disposition or bodily residue is related, either as cause or as concomitant, to the symptoms or afflictions which occur in a wide variety of "mental" disorders. Psychoanalysis has also made it appear that the possibilities of memorial revival are much more extensive than any one had supposed. It suggests many new incentives to recall. Because human life is complex and human experiences highly individualized the memories when once they are elicited require a good deal of divination and guessing on the part of the physician or analyst. Since no one but the sufferer is likely to hold the key to a particular memorial situation, we can see the practical advantage to the clinician of having at hand types of characteristic experiences to guide him in interpreting and supplementing the memorial scraps which first come from the patient's laborious efforts to recover the past. Thus one school looks for incidents connected with sex, another for thwarted desires of various kinds, and still another for old insults offered to the person and character of the patient. It may be that in time a rational method of diagnosis will be evolved appropriate to the nature of the disorder and of its origin, and that this method will be supplemented by a wider knowledge of the proper means for evoking the memorial functions than we now possess. Apart from the therapeutic value of such clinical resources, the collection of a large number of memories would be a first-rate aid in reconstructing the total individual. Already the psychoanalytic literature abounds in gross depictions of individualizing differences to be found among human beings.

CHAPTER XI

THE MODES OF APPREHENSION: III. IMAGINATION

The memorial functions, as we have seen, always localize an experience in the rememberer's past. Imagination does not. It may create the same kind of experience; but it gives it a different setting. Its setting is more varied than that of memory. There is only one personal past; while there are several directions in which the objects and events of the imagination may be referred. Let us consider these imaginational references.

Anticipations of the Immediate Future

It appears probable that the organism's first successful attempt to get away from the momentous and exigent present directed it toward the about-to-be, toward the immediate future; permitted it to look-round-the-corner of experience and to prepare for the events to follow. These anticipations are easy to manage because they do not require the annihilation of the perceived present; they are rather organized, so to say, on the edge of it. The apprehension of present objects and events is extended to include future phases. We apprehend the coming of the wind when we see the trees begin to bend in the distant wood, the appearance of the noisy street car before it comes into view. The success of a game or a competition in skill similarly depends upon the anticipation of the opponent's movements. This imaginational extension into the future, the root of imagination, is facilitated by our telepathic senses, sight and hearing, which serve to anticipate turns in experience and so to prepare for coming events. At this stage, the reference forward is little

more than an appendage to the perception. It is the present situation giving notice that it is about to suffer a change. The next step in our progress from the apprehended present is provided by the free secondary incorporation. Thus we hold "in image" the appearance of the station and the train before we leave the house for the journey, the sound of the five-o'clock whistle when the work of the afternoon begins to grow arduous, the sight of the audience-room where our address now under preparation is to be delivered. Here we have a temporal reference which is complementary in direction to the memory. It bounds the present on the opposite side. Conditions underlying this difference, past and future, we do not fully know. It is easy to appeal to two separate powers of mind, memory and imagination, but the appeal gives us nothing but names. A more empirical solution points to the feeling of familiarity, present in memory and absent in imagination. But we have seen that familiarity does not carry us far in memory. Since it is present also, in varying degrees, in perception, it is insufficient to supply a temporal place. Imaginations, too, may be familiar. The visual image which means the railway-station-as-I-shall-see-it-in-an-hour may be wholly familiar and still refer to the future, and the imagery which accompanies certain particular stanzas which I frequently find hypnogogic on wakeful nights is as familiar as the current copy of the *Atlantic* which I remember as having read last night; and yet the stanzas come with no memorial reference. No; familiarity and its want, or familiarity as contrasted with a positive feeling of strangeness or of novelty, is not a sufficient differentia of memory and imagination. Certain other differences have been suggested; the character of eye-movements, imitative and empathic attitudes, and the instability and coherence of the image.[1]

[1] C. W. Perky, *American Journal of Psychology* (1910), Vol. XXI, p. 435; H. Clark, *ibid.* (1916), Vol. XXVII, p. 461; E. B. Titchener, *A Beginner's Psychology* (1915), p. 184.

It is very doubtful whether these are essential differences which really determine the reference in the one way or in the other. The exceptions to the rule make us skeptical. When we scrutinize the organized unit of the secondary incorporation and observe how easily it fits into the one function or the other, the memory or the imagination, we are inclined to believe that it is rather the neural disposition, either momentary or sustained, which determines the direction of meaning.[2]

At times the mere intent to recollect or to previse is sufficient to divert a coming imaginal complex toward a memorial or an imaginative function. Thus I say to myself "remember," then open a book casually and read "star," the first word which strikes my glance. Immediately I am seated as a small child upon the doorstep in the evening reciting a wish, "Star, star, shining bright, etc.," as I look toward the heavens. Again I instruct myself, "imagine," and turn to another page, read "complexity," and consider imaginatively the many aspects of the present subject which must be treated within the next ten pages. Not always will the imagination take the tinge of futurity; for there are also other forms of the function, as we shall presently observe. It is wholly likely that the memorial or imaginational "set" is encouraged by posture, eye-movement and mood;[3] but

---

[2] Acquire visual or auditory total images suggested by the following words and insist that each fits, first into a memorial, then into an imaginational setting; field, tree, Rebecca, ice, disappointment, caress, Shakespeare, sonata.

[3] For example, I seem to aid recollection by lowering my head and rubbing my wrinkled brows, and to conjure anticipation by staring blankly ahead. Very likely these postures are remnants of "conditioned" associations. Perky inferred from her experiments (*loc. cit.*, p. 422) that the memorial function of imagery was connected with ocular movements, which she found, as a rule, to be wanting to the imagination; but Clark, who observed movements of the eye under three different methods, concluded (p. 461) that these movements were rather indicative of the nature of the objects imaged and of general states of the organism than of any functional difference in

we have no credible evidence that any particular set or kinæsthetic attitude or mood is the universal and invariable condition of the one reference or the other. This skeptical view is encouraged by the fact that under experimental conditions we have, instead of two clearly defined classes, "memories" and "imaginations," a large number of functional gradations exhibiting many differences of location, stability, richness, associative support, temporal setting, bodily reference, affective coloring, and so on. Thus we seem rather to find various points in a continuous series than sharply distinguished functions.

The Imaginational Accompaniment

Next after the anticipatory reference in imagination we turn to the imaginational accompaniment. The best instance is the imagery which runs along with the novel we are reading. The thread of the plot is mainly carried in accompanying figures and scenes. Such an imaginal annotation, again, is an aid in the reading of history and in the comprehension of descriptive science. We have recourse to it also when we take part in conversation and when we listen to lectures and addresses. When we actually lose ourselves in the novel we build up a fictitious present and perceptually behold the creatures and events which are the joint creation of our author and of ourself. Here the externally aroused

---

the imagery. Perky understood by imagination an imaginal presentation of some general, non-localized object, "not recognized as this and that particular and individual object." These are our images of general reference, only one of the numerous grades and classes of imagination. We cannot generalize from such results to imagination at large. If Perky had taken the usual imaginational setting, where events are rich in context and closely integrated in their trains, her distinguishing marks for memory and imagination might have vanished. As regards inspective differences at large, five independent investigators have come to conclusions so diverse (*Cf.* Clark, p. 488*ff.*) that we shall do well to withhold our judgment until more exact analysis and more precise definition are at hand.

perceptions recede. The book, the table, the window, and the noises of the street lose their meaning. The qualities necessary to their continuance fall into the background. They hold together just enough to touch off and to maintain the flow of imagery in the accompaniment, which finally becomes the main performance. Here the imaginational functions have really become perceptual. We are in the same kind of coherent and fluent situation as we enter in regarding a satisfactory moving picture, where the screen and the audience are left out of account (not really "forgotten") while we simply observe. The success of the moving picture doubtless rests upon its ability to relieve the organism of preparing this imaginational construction while reading, and then of translating it into perceptual meanings. The habitué of the picture theater immediately perceives. Both a defective command of language and a defective imaginational setting for the written page incline the feet of the public away from the library and toward the cinema.

The Detached Train

One further remove from perception is the detached train. This variety is commonly known as phantasy or passive imagination. The reference is undated. Thus we "let ourselves go" in daydreaming, we carry through imaginary conversations or we think of the repartee that escaped us at the moment when we might have been brilliant. The relation to the present is remote. These imaginations are fragments of possible events, supposed bits of living. On the mental side, we have sensimaginal trains which are supported by a ligated series of associative tendencies in the brain. In the verbal types, the picture-images are likely to be supplemented by a running conversation in which, as in Landor's *Imaginary Conversations* or in conversational dreams, the imaginer takes one part after another, adapting to each speaker his appropriate lines.

A large part of the *active* or *creative imagination* belongs to the elaborative functions. As men propose and solve the problems of thinking by the symbolic use of verbal and other meanings, so do they construct under the stress of some great desire a plan which is wrought out in the form of the novel, the drama, the sculpture and the architectural creation. The description of the psychosomatic functions involved in these "creations" must then be postponed to their appropriate place. Here we restrict our inquiry as closely as we can to the apprehensive functions. But in so restricting ourselves we must not take too literally the "creation" of the books. The word suggests—and many psychologists unfortunately confirm the suggestion—that remembering, anticipating, commenting and daydreaming are purely "passive" and "imitative" functions in which mind only regurgitates, echoes, and patches up the old; while the real imagination devises its own materials and creates its own objects.[4] The distinction belongs rather to æsthetics than to psychology. So far as it does touch psychology it points, as we have just suggested, to the difference between the apprehensive and the elaborative functions and not to any contrasting pair of active and passive powers of mind.[5] Even among the apprehensive functions we cannot set perception down as a mere stamp of the die and memory as a mere "reproduction" of the old. Each function of the psychosome is a new event, however far it may be influenced by stimulus, predisposition and central set. In the realm of memory and imagination these functions carry us no further than the imaginal train, *i.e.*,

---

[4] So Ribot in speaking of memory says "toutes ses réviviscences sont des *répétitions;* or l'imagination créatrice exige des *nouveaux.*" *Essai sur l'imagination créatrice* (1900, p. 3).

[5] The opposite contention, common among the associationists, is that all the "creations" of art and of fancy are only reassortments from the scrap-heaps of memory. This view is as illegitimate as the other. It rests upon the analysis of objects, not upon the distinction of our psychosomatic performances.

the connected and integrated structures which form either the memorial recital or the integrated fiction. Both grades of function correspond to the perceptual train, where the chief guidance lies, as we have seen, outside the organism. In both the memorial and the imaginational train the outside guidance is replaced by a central predisposition; in the one case, the disposition sustains a connected series of associative tendencies which carry the memories; in the other, a like series of functional tendencies which carry the imaginational train. A memorial instance appears where we commit the past day's events to an intimate letter; an imaginational train of a like grade is the tale with which an elder seeks to entertain a child or the projection of a series of idealized experiences with which one may seek to escape from the sordid world of reality.

Imagination as General Reference

When we were considering the organization of the total image we saw that an integrated structure of the imaginal kind might carry a general reference which meant no object in particular but rather any-object-of-a-class. We have seen further that the tendency among perceptions repeated with small variation is to give rise to total images of this kind. These images are certainly not memorial; and it is extremely doubtful whether we can with propriety call them imaginations. Imaginations seem to require a degree of particularity which may inhere in the total image itself (as when I imagine my appearance in the mirror) or may derive from the setting (as a rescue at sea described in a novel).

The apprehension of the general, detached objects is an accomplishment of the first importance to the organism. It removes the organism from the biographical current of events, freeing it from the limitation of times and places. Not only does it supply the material for new constructions, such as the sustained fiction. It also gives us detached imagery which

easily takes a secondary or symbolic meaning—a meaning at two removes—and which leads, as we shall presently see, to abstract thinking and to other forms of elaboration. Thus when a detached image of a studious youth poring over a large book by candle light comes to mean persistence-under-difficulties, this "meaning of a meaning," or symbolic reference, indicates a progression toward abstract thinking.

We are familiar in this connection with the composite portrait, having been assured by psychologists that our materials for thinking all come from "sensation" by way of the concrete "image." We have been wrongly persuaded that numerous like impressions are stamped one upon another effacing the individual lineaments. Whatever restamping there is refers to the nervous system. Images do not overlay each other. What a thousand perceptions of my dining table during the year do to my central nervous system no one actually knows, beyond the repetition of a fairly complex neural function with slight variations and in various settings. The doctrine of associative tendencies leads us to believe that the minor variations go beyond the ability of the central nervous system to preserve and so they are either actually expunged or mutually inhibited and checked. That they are not *all* expunged by repetition we know because the total-image which means at this moment just "that dining table" becomes after a moment's retention the "table-last-night," "my-last-birthday-party," "the-night-I-entertained," and so forth. But on the side of experience, no composite, no over-laying; only a certain present integration of sensimaginal processes, carrying, under the influences of the momentary bodily state and tendency, such and such an objective or else symbolical meaning.

CHAPTER XII

THE EXECUTIVE FUNCTIONS: I. ACTION

The Psychological Aspects of Action

The business of living keeps the creature active. A constant interchange goes on between the organism and its surroundings. Observe your own activities for a half hour. Note the turning of the head to look or to listen, the manipulation of objects, shifting in the chair or on the feet, walking, speaking, exploring, the taking of food, dressing, greeting companions, and so on and on. In animals life does not go far without movement. The very processes of metabolism throughout the body require that the creature shall suitably maintain by movement his relations both to the gross physical agents, such as air, light, moisture and a favorable temperature, and to particular and varied objects, food, companions and shelter; in short, the whole changing panorama of the environment.

Now these movements of the organism interest the physiologist. They represent one great class of the bodily functions. The physiologist may leave the "mental" or experiential part out and seek to ascertain how the movement-apparatus—bones, muscles and tendons—is made, how it works, and how it is controlled and coördinated by the nervous system. The movements also interest the biologist. He sees in them devices for maintaining the organism and for moving it from one place into another. He is likely to regard them as an adaptive mechanism serving the organism. The study of movement or behavior is a kind of active or dynamic ecology seeking to describe the way in which the

individual disposes himself in his changing surroundings. Again, the student of sociology observes the performances of men in order that he may understand their conduct and the ways in which they accommodate themselves to each other in society.

Some psychologists regard these three treatments of organic movement, the physiological, the ecological, and the social, as exhaustive. But if we stop with them, we shall fail to see that movement enters, in a characteristic way, into one of the great types of function in which mind and body are inseparably conjoined—into the executive type.

By action we shall understand something more than bodily movement, something more than the putting forth of the hand to grasp or repel, or of the movement of the legs in flight. We shall understand an unique mode of functional coöperation. Action is a group of executive functions. In action the organism attacks a problem, a problem which it solves in an executive manner. A complete and typical action is characterized by three stages. First there is the action-problem. Something is to be done; the ink bottle is to be opened, the call from the next room answered, the friendly handshake to be returned, the plan made for closing the house at night, the direction to be selected on the trail, the motor car guided through the street, the piano keys to be struck in the production of music. We are constantly formulating action-problems. But, in the second place, the problem is not only to be formulated; it is to be wrought out as well. The executive function includes also the solving. In the course of the action the problem is on its way, the performance is in process of execution. The action progresses. And, finally, in the third place, appears the solution. The thing is done. Some bodily movement is carried through and the action is complete. The function is thereby terminated.

Let us see now what factors, physical and mental, are in-

volved in this executive kind of performance. First, the setting of the problem frequently, though not invariably, includes a perception or a representative image—the ink bottle I see, the call I hear, the hand clasp I tactually and kinæsthetically "feel," and so on. That is to say, the theater of the action is set before the actor in apprehensive form. But the apprehended object is an occasion as well as an object. Its meaning includes an anticipated change. This reaching forward in action is sometimes called "determination," sometimes "intent," sometimes "idea of the goal." On the mental side, we have all the factors which make up the motives and incentives and which carry the meaning of anticipation; and within the central nervous system, we have trends, dispositions and tendencies toward functional activity. These functional trends within the body have been variously acquired in previous experiences. Sometimes they are released by the perception itself, as when we see a vagrant hat rolling toward us in the gutter; sometimes the general organic state, such as hunger, starts the neural trend; and sometimes associative processes touch off a need or a desire and so lead toward execution. The executive function, then, is a *determined* function, and it leads toward its own resolution. The working through of the determination, the action in course, may utilize any mental materials at hand. There are no specific "action" processes. It is the neural predisposition which holds the action in its course, and which suggests the action-meaning to whatever qualities and structures appear. At one stage in the analysis of action, it was supposed that the anticipation and forward-running part of the function demanded a particular kind of idea, an idea or image of movement, which led up to and introduced the actual contraction of muscle; but more careful analysis made it evident that this supposition was wrong. Indeed it has appeared that in some actions the determination may not be represented by any mental factor whatsoever, as when the hand plays with

the watch charm or the paper knife as an absorbing conversation progresses. Such a highly automatized movement may be merely physiological, not diverting or employing experience in any way.[1]

We are all familiar with the common classifications of action. The commonest separate instinctive from acquired action or voluntary from involuntary. Neither distinction is valid. The one points to a difference in origin, racial endowment and individual acquisition; the other to an alleged faculty of will. We must seek some other principle. If actions are psychosomatic ways-of-doing, then the varieties or kinds of action must somehow have different functional marks.

The varieties are not, as a matter of fact, wholly distinct classes. There are many variations, in complexity, in shading, in temporal course, and in the relative prominence and importance of mental and physiological factors. We can only exhibit the grosser differences, leaving the transitional forms out of account.

The Simple Impulsive Actions

First we have those simple and direct actions which are based upon a clear perception and which run their determined course without check or complication. Such an action is the picking up of a piece of toast at breakfast when it has become suitably browned in the toaster. It is only the clear apprehension of the browned piece that initiates the action. But the action is more than the mere perceptual apprehension. Along with the meaning, "this toast is done," there

[1] The peculiar thrust or forward-tendency of the executive functions, which is a mark of the action-determination, has led some psychologists to believe that there was a peculiar kind of mental "process" which they have called "motor consciousness" or "conation." There is, however, no inspective justification for its existence. The term confuses the existence side of mind with the coöperative functions which we are here discussing.

runs a determination which is represented on the bodily side by the prompt integration of central tracts and on the mental side by kinæsthesis and (at times) anticipatory imagery. The total meaning of the determination is "this piece is to be taken and buttered." In the laboratory this variety of action has been much studied under the name of the "sensorial impulsive action." In the phraseology of research "attention is on the stimulus." Under the experiment of the laboratory the actor is under instruction to move (say, the customary finger upon the key) when a color, figure or sound is clearly apprehended. Inspective analysis of the mental items in the reaction has been greatly facilitated by the method of fractionation, which confines the observation first to the preparatory step of the action (the "fore-period" before the object is presented), then to the short interval when the determination is developing and the movement taking place (the "mid-period"), and finally to the period of observation and report which succeeds the action (the "after-period"). In a highly trained observer these simple actions, built upon a perception and a determination, occur time after time with small variations in the mental and bodily components and with a constant temporal course (about 1/5-1/4 second with visual perception). In this experimental form of the sensorial impulsive action the determination is, so to say, "artificial." It is arranged for outside of the perceived color or figure or sound. The observer is instructed that when he sees or hears such-and-such an object he is to attend to it and then to depress a key with his finger. The instruction is a kind of priming; it sets the determination, and the determination leads up to the perception and then is released when the perception comes. In our everyday actions the priming is, as a rule, less obvious. We do not rehearse the action in advance. The brown toast, for example, is simply at hand ready to be taken and eaten. But even in these unpremeditated cases, there is a priming; the central nervous system

is predisposed. It is not inert, unprepared. If it were, our simple perceptions would not set off determinations and we should act only by some laborious and roundabout means. Even behind the unreflective chase for the hat blown into the gutter there is a history of preparation on the side of the central nervous system. What happens when we are not primed, when the action fails to develop, we know from certain pathological states where the patient perceives but does not know what to do and so remains inactive or performs foolish and inappropriate movements. Some men have contended that without action, *i.e.*, without a determination carrying itself out in organic movements, no perceptual meaning could arise; but we have found reasons for separating the perceptual and the executive functions. One may involve the other; but they are certainly not identical and not always conjoined.

Those who depend upon movement to inform every sort of mental fact with significance are accustomed to fall back upon the principle of dynamogeny, the alleged passage of every inward-running neural excitation through the brain and out again into motor channels and so toward muscular contraction and tendinous pull. As for this principle, we do know, of course, that the brain is never wholly blocked off from the organs of movement, maintaining at the least the tonicity of the muscles; but it has never been shown that the brain is merely a sieve or a readjustor, a halfway station between stimulation and movement. The principle has the appearance of a dogma which is convenient for the naïve behaviorist who seeks to couple every "stimulus" with a corresponding "response." As against the validity of the principle we may first observe that it demonstrates too much. If the brain were merely a pervious medium connecting the receptors with the glands and muscles, we should have, at any moment, thousands of areas of stimulation from the skin, the viscera and the more highly specialized organs of sense

initiating thousands of discharges—a condition which does not, so far as we know, exist. Again, it is hard to see how such a pervious central system constantly relieving itself by discharge should nevertheless retain in some manner and for an indefinite period the multiplied effects of its own functions as well as the residues of antecedent generations. Once more, we have, as against the dogma, the positive fact of inhibition which means the closing of motor outlets and the fact of central absorption or dissipation, which means the central exhaustion or at least the transformation of the neural currents. But even without these limitations to a universal motor discharge, there would be no guaranty that the organic movements which ensue, let us say, upon a perceptual or a memorial function would serve either to create the perceptual meaning or to constitute the action. In fact, we observe in certain emotional states a general and diffuse spilling over into the motor pathways—a kind of general motor explosion, as in terror and rage—which destroys instead of completing the action-determination. The selected and coördinated movement or movement-train resulting from specific central determination completes the executive function; but it is the determination and not primarily the resulting movement which informs the action with meaning.

Our second instance of action substitutes a sensimaginal for a sensational incorporation. This morning the sudden downpour of rain recalled my open door upon the balcony, and I jumped from my study chair to hurry home. The memorial image touched off a determining tendency and led to movement. Frequently do these imaginal anticipations release prophetic actions which provide against the immediate future. The same executive end is attained by way of imagination of the fictional kind, as when a bit of poetic construction leads me to reach for my pencil that I may record a fugitive inspiration. All of these actions, however, bear a family likeness. The core is an apprehension of

some kind which touches off a prepared central trend and which ultimately issues in appropriate movements.

A variant of this type of action is *the impulsive train.* During the World War the Air Service used, to determine the sustained performance of the aviator, a bank of miniature electric lamps which could be lighted one after another in a chance order. The flyer was instructed to make an appropriate movement the instant each light occurred. He performed a chain of actions with a single instruction, *i.e.*, under a single continued determination. Each perception had to be clear and each movement led immediately to a new perception. In industry, again, the attentive guarding of machines, which momentarily shifts the task to a new movement, calls forth this kind of action, an action which is a progressive adjustment, through movement, to unforeseen changes in the environment.

The Automatization of Actions

We should, however, give an incomplete account of actions were we to neglect the startling effect of repetition upon these functions. The novice at the piano or upon the typewriter begins with the sort of performance which we have described, simple acts and action-trains; but the performance soon changes. The first modification appears as a foreshortening. The perception shrinks. Individual notes upon the staff are no longer apprehended as individuals. They come in groups and their meanings are group-flashes. Again, the individual determination which leads from this or that note upon the score to this or that movement toward the appropriate black or white key disappears. After the group-flash comes, without intermediation, a sequence of rapid movements. Still later, the score may wholly drop out of clear perception and serve as a vague and obscure cue to a complicated series of movements. The sound itself as it flows along may be the controlling object and then we have the

curious fact of an action where the perceived object is the result of the action and not its antecedent. This stage informs us that the action is becoming automatized. That means that the original perception is dropping out; that a single determination is holding together the entire complete act and that it is almost or entirely without mental factors. When the foreshortening reaches its limit under repetition the movement which was before the final term in the action now becomes the initial term. It is immediately touched off without antecedents. We find it in the jump at a harsh command, the guarding duck of the head under a sudden blow, and the withdrawal of the hand from unobserved contact with an icy surface. These simple, direct, and highly specialized movements under stimulus stand very closely related to the physiologist's reflex. Although they may have high significance for the organism they stand as a limiting case of our class of psychosomatic functions.

These simplifying changes are sometimes regarded as a degeneration of action. They have been exhaustively studied in the reaction experiment. When the person reacting is simply instructed "move your finger as quickly as you possibly can upon seeing the color," it is generally found that he "reacts" more and more quickly as time goes on. First, the "sensorial" reaction gradually assumes a "muscular" form. Without intending it, the actor has changed the determination underlying his performance. Instead of a clear perception of the initiating object or sound, he makes way for the movement. Where his self-instruction takes the verbal form it runs "I will get all ready to move," "I must move rapidly," "here I go" and so on. On the bodily side this instruction means that the movement of the hand and finger is facilitated, and so it occurs earlier than before. The entire organic set has shifted and the mental factors suffer a corresponding change. The color or sound which before furnished a clear perceptual meaning now serves only as an

obscure hint to discharge the movement. It appears only as a flashing change. Kinæsthetic qualities become more prominent and movement concerns more generally the entire organism. If this motor set is further encouraged, the actor comes finally to the *acquired reflex,* where the actual movement is preceded only by a vague suspense and where it seems to come quite automatically and of its own accord. The stage of muscular reaction occupies (for vision) about 1/7 second as against 1/5 to 1/4 second in the sensorial form; and it may further decline to less than 1/10 second under the process of automatization.

In the experimental study of these forms of impulsive action it has been found that in the mid-period, *i.e.,* while stimulus is being applied to the receptor organ and the movement is taking place, the chief difference on the mental side is in organization. Where the apprehensive function runs its full course, the clear and carefully organized members carry the object-meaning. The determination to move is either vaguely represented by verbal or other kinæsthetic complexes or the apprehensive stage is followed by a clear instructional stage which carries the meaning "I must move at once." In the muscular reaction, the kinæsthetic factors carrying the movement task are clearest; the factors carrying the apprehension of the object extremely unclear and extremely fleeting. In the preparatory (fore-) period a wider gradation appears. Here Ach has distinguished for us no less than nine different forms.[2]

Sensorial

1. The extreme or pure sensorial preparation. Vivid anticipation of the coming object with steady fixation of the place where it is to appear.

2. Sensorial preparation. The same; but with a prophecy of the coming movement.

3. Sensorial-phenomenological preparation. Expectation of the object in verbal terms ("now it is coming") or in visual image *plus* the motor prophecy.

---

[2] N. Ach, *Ueber die Willenstätigkeit und das Denken* (1905).

4. Sensorial-muscular preparation. To (2) or (3) is added actual kinæsthesis from hand or face.

5. Temporal preparation. The object is expected; but now its meaning is extended by the verbal imagery "as quickly as possible," ligating in close temporal succession the object and the movement. A strong intent to condense the interval between object and movement.

Muscular

6. Muscular-sensorial preparation ("central type" of Martius: "natural reaction" of Wundt.) Kinæsthesis meaning "I intend to move," connected with an expected change in the area of visual fixation.

7. Muscular phenomenological; visuomotor preparation. No movement carried out (kinæsthesis), but the movement-meaning is given either in inner speech or in visual imagery (*e.g.*, a picture of the moving finger).

8. Muscular preparation ("kinesomotor" of Flournoy). Kinæsthesis carrying a strong intention to move as quickly as possible, so soon as an awaited (visual) change appears; a double change condensed into one meaning.

9. The extreme or pure muscular preparation. Kinæsthetic intention to move without reference to the coming object.

All of these simple actions, sustained under experimental conditions, are stamped by the intent to move as quickly as possible. This intent colors the determination which shows itself on the mental side in all these nine different preparations of Ach's. We find it also on the running track, in forced mechanical operations of the factory, and in competitive games; but in most of our daily actions the preliminary resolve "I shall move as quickly as possible" is wanting; all degrees of alertness and laxness appearing and the suitable movement being fitted to the event when it transpires. The executive determination does not, then, invariably require this preliminary preparation. It appears in the experimental setting of the reaction experiment, in part, for historical reasons. (The experiment grew out of the astronomer's observation of the precise instant of stellar transit and out of the physiologist's attempt to measure the rate of conduction in the living nerve.) And in part it came from the necessity of simplifying and standardizing the action for the purposes of study.

When we leave out of account these finer gradations we find in the two primary forms of impulsive action, the sensorial and the muscular, a distinction common to many of our grosser performances of everyday life; the tendency, namely, to give the chief place either to the apprehensive side ("attention to stimulus," as the psychologists say) or to the impending movement. When we scan the face of the clock and then run to meet an engagement we act in the one way; when we race from the scratch at the sound of the starter's pistol we act in the other. Since we are describing in terms of the executive function, it will be better to discard the terms sensorial and muscular and to speak of the *apprehensive* impulse, including the imaginal along with the perceptual, and the *motor* impulse. They represent a real functional difference, as we have shown. In our simpler performances we generally incline in the one way or in the other. When we have to fit our actions to the particular nature of some object or person or event, we perceive clearly and we unite the determination with the perception; and when the action only needs a hint from the object or event, we act triggerwise with only a fleeting or a vestigial perception, and at times upon the bare hint of an undefined change. As a general rule, the better we become acquainted with our accustomed surroundings and with the appropriate movement for a given occasion, the more the perceptual side is abbreviated and the more surely and promptly the action develops from a delicately adjusted determination.

After the foreshortening has gone a considerable distance we say that we act "automatically" or "involuntarily." It is better, however, to avoid the terms "voluntary" and "involuntary" because they suggest the presence and the absence of a peculiar faculty of will. The tendency toward automatism represents a common trend in all our psychosomatic functions. We tend, upon full acquaintance with a situation (as under frequent repetition), to practice economy by

short cutting. Our living rooms scarcely call for perception. We take them for granted. Our actions in dining and in saluting our friends run themselves through with mechanical smoothness. We perform them "without thinking," as we naïvely say. We find the station empty and the cabs gone and we "know" that the train must have passed; we decide without taking the trouble to argue the matter through. We see the sun on the left side of the car as we enter and so are spared the labor of learning that it is better to sit on the right. It is thus with all our functional accomplishments. The organism practices economy; it exemplifies the principle of parsimony.

Nowhere is this tendency to cut corners, to abstract from detail, more striking than in action. Wherever we can act automatically we save time; we save friction and labor, and we save our energies for other tasks. If we had to dress and breakfast each day with care in all details (with "sensorial preparation") we should not begin the real work of the day before noon. Especially is the process noteworthy in those executive trains which result from long practice in what we call "skilled" actions. Thus the juggler who maintains several balls in the air with one hand; the virtuoso who plays a new score at lightning speed; the cashier in the department store who makes change for a dozen counters. Here the foreshortening has a double source; the perceptual functions are reduced almost to the point of elimination, and the determination is set to include a whole series of successive acts, one phase following upon another. The same process of reduction and abstraction occurs in the performance of the trained animal which comes to "respond" with precise and inevitable movements to the faintest and most fugitive perceptual cues from its trainer. The uninitiated onlooker marvels at the "intelligence" of the educated horse or dog, not realizing that at the end of its tuition the animal is not even perceiving, to say nothing of reason and "sagacity." For

such skilled accomplishment, it is only necessary that some outside change should so affect the organism as to touch off a specific determination toward the appropriate movement. All the sagacity and intelligence lie in the trainer, not in the automatized animal.

This tendency toward short cutting and economy is favored by a peculiarity of neural function which we have already met in the conditioned reflex and in association—the tendency to transfer the determination from one perception or one cue to another. Any one who has called the cat to the kitchen door for food knows that when food has first been given with the call the call later serves to bring the cat without the sight or the smell of food. A purely secondary and adventitious element in the original apprehension entering into the action is now sufficient to set the determination and to initiate the performance. Instead, then, of cutting short or telescoping the main or essential part of the original perception, it is only necessary upon repetition to have a single small and insignificant part of it touch off the coördinated movements. Constantly our more prompt and automatized actions are so determined. We drop work at the whistle blast or change classes at the sound of the gong. We step aside at the warning claxon without waiting to perceive the approaching machine. We put on rain coat and rubbers when we hear the drip of water at the eaves. Quite casual accompaniments of objects and events come thus to serve as surrogates standing for—so far as the impending action is concerned—a previous total situation. When we come to the emotions we shall again observe the same kind of substitution or transfer.

Equivocal Actions

But action does not always run so simple a course as we have described. We started with the fusion of the perception with the determination and we have observed the ab-

breviations of this apprehensive impulse at various stages of condensation. Now we must observe that the executive functions also take more elaborate forms. Compare the selection of a seat in the street car with the dropping of the nickel into the conductor's box. In dropping the nickel the perception of the box determines the action and leads to the deposit of the coin. In selecting the seat something else is injected into the action. One may—we will suppose—sit right or left, outside or inside, before an open window or over a heating coil. That means that the apprehension of the place will not immediately lead to one single set of movements. "Choice" implies that two or more possible determinations tend to complete and extend the perception. So at table, if I am not quite certain of my tools, I may begin by using a dessert spoon or a bouillon spoon. On the road, I may take the right turn or the left turn. The perception is equivocal. Now what happens to the executive functions in such cases?

Well, the easiest way out is to be prepared, primed, for the one action or the other. That is to say really to avoid a choice. For many emergencies we are so prepared, and then the choice is only apparent. One may, for example, decide that while the heat lasts only the shaded car seats are comfortable or that one must sit outside for health's sake. After that the rival determinations are killed. Only one sort of seat is considered. Behind our actions lie many special rules of this kind. We decide that the "eastern side of the street is best," that "good manners prescribe the place of honor for the guest," that "the small table in the corner at the club is the most comfortable nook," that "chocolate at breakfast is better for one than coffee," and so on through the day. We constantly rule out alternative actions and so avoid the trouble of making a choice. Many times it is just this pre-decision set down as a rule which gives to our actions the appearance of freedom. There seems to be a deliberate and arbitrary

choice when no choice at all, in the sense of a double determination, actually exists. But we now leave these false choices aside to examine the case of true double determination. First let us turn to experiment.

Action with Double Determination

The movement side of the either-or actions and the determination behind the movement have been studied in the "reaction with multiple coördination." Two objects, *A* and *B*, are to be presented in irregular order and the actor is instructed to move, say, the right forefinger if *A* appears and the left forefinger if *B* appears. Here we have not, to be sure, a complete choice, because *A* determines one movement and *B* the other. The triumph of one determination, as we may say, is not left to the organism; it is rather foreordained by the instruction and the perception. So it is akin to the false choice by rule which we have just now examined. But the two determinations thus brought close together present an opportunity for observing certain aspects of this type of action. The action is variously initiated in the preparatory period while the actor awaits the object *A* or *B*. *E.g.*, there may be general tendinous strain which means "here (at fixation) something is to happen and then appropriate movement is to be made"; or both hands and arms may be innervated and the resulting tactual and kinæsthetic qualities may mean "I am ready"; or "*A*-right: *B*-left" may be rehearsed in inner speech. With increased practice, as usual, the organism simplifies the task. There may be then in the fore-period only a vague intention, sustained by weak kinæsthesis, decreased clearness without any rehearsal of the instruction. Here, we must suppose, a sort of hypothetical determining tendency forms in the central nervous system which provides, without corresponding mental concomitants, for the appropriate movement of the finger. Were it represented by quality and meaning, it would run: "If *A*, then right-hand movement;

if *B,* then left-hand movement." So we have the two issues provided for in the one neural tendency. In the mid-period occurs a perception of the object, *A* or *B,* along with the meaning "right movement" or "left movement." With practice the perception becomes more fleeting and less clear and the intermediate movement-meaning drops out. The purely physiological determination directly provides, then, the impending movement. This kind of either-or determination plays an important part in many manual operations which are not wholly mechanized; and in the reading of music, the use of the typewriter and the give and take of tennis, appear long temporal chains of automatic movement which began as separate disjunctive acts of this alternative kind.

To make a real choice we have only to provide an impromptu determination to replace the prescribed "either-or." Thus when I observe among the new books at the library a volume by Joseph Conrad and a recent work on pre-historic man, both books attracting me, I have the materials for choice. I may take either. The determination which leads me to carrying off the Conrad has somehow to take into account also the anthropological work. What now is peculiar to this selecting execution?

Look at typical experiments! I provide two numbers, *e.g.,* 8|2, upon an exposure card, and I instruct my observer that "a card with two numbers will appear. When I call 'now,' decide whether you will add the one to, or subtract the one from, the other, or simply do nothing. When you have carried out the operation call out 'yes.'" Characteristic inspections for the preparatory period give "addition" or "subtraction" in (1) inner speech, in (2) visual imagery ("+," "–"), or in (3) a perception of the blank fixation-area with the meaning "add" or "subtract." There is also a forward-straining expectation usually carried by strain. Upon exposure and during the mid-period we find perception of the numbers and the operation ($8 + 2 = 10$ or $8 - 2 =$

6) accomplished in verbal or visual terms. Upon practice the result "10" or "6" is likely to appear immediately with the perception without intervening processes. In these cases, whether the self-command "add" or "subtract" appears seems to be due to the relative strength at the moment of the two corresponding associative tendencies. No mental factors usher it in. It appears from the experiments that the one mathematical procedure occurs about as frequently as the other, indicating that the tendencies are of the same order of strength. But once the meaning "add" or "subtract" is realized, it represents a determination which automatically initiates the operation ("$8+2=10$" or "$8-2=6$"). The potency of this determination is shown by giving in hypnosis the instruction, "When two numbers are shown you on a card give the sum (or difference)." The numbers are then shown upon awaking and the person immediately calls off "10" (or "6") without running through the operation and without knowing why he should so respond.

In these simple cases of choice we seem to have on the side of the executive functions no essentially novel factor. We have said that determination is an invariable mark of this whole class of functions. The later stage of the operation is set or determined by the earlier. In the various sub-forms of the apprehensive impulse the movement is determined either by the perception itself or (as in the experimental "reaction") by formal instruction. Again, in the false choice, we find the determination set by a rule; in the partial or incomplete choice by a hypothetical determination, and in the real choice by the possibility which is realized under the stronger associative tendency and which, once realized, creates the determination to "add" or to "subtract." It might be thought that the "add" or "subtract" simply carries through the exposure period guiding the appropriate operation. There is no inspective evidence for this supposition. The command to add does not linger and reëcho. The opera-

tion is really a new stage in the whole function, being the functional outcome of the earlier stage. The progression seems to be a characteristic sequence of this kind of performance in which mind with its meaning and the nervous system with its nice disposal and transformation of energy unite in a single operation.

When we come to what we commonly call our "voluntary" actions, we find, as we might expect, that the everyday cases are somewhat more complex than the experimental. Even the choice of the Conrad or the anthropology is likely to be. Thus the carrying off to the loan desk of the Conrad may be preceded by such comments as "I liked his last," "a good deal has recently been said about primitive man," "what attractive illustrations!" "the Conrad will be taken out before I come again," and so on and on, each one of these accessory meanings now favoring the one main associative tendency, now the other. Of course I may take the case right out of the "choice" class by a private rule, "I take only fiction from this library" or "I have no time for novels," and so make the determination unequivocal. To be sure, even rules are broken. Were they not, conscience would have few terrors. They are, nevertheless, our main dependence when we wish to avoid the hazards of choice; and we find all manner of sanctions, social, religious, ethical and æsthetic, to fortify them and to place them beyond the reach of rivals.

Another way in which choice is complicated is by the appearance of hindrances to execution. When in the experiments on choice the determination commanded "subtract" and the numbers then fell out "2|9" the impossibility of taking "9" from "2" checked the discharge of the determination; so with "divide" the numbers "5|4." The same check appears when we determine to leave the open fire and go out in the storm only to discover that overcoat or umbrella has been mislaid. Where the determination is of sufficient driving power it survives the delay or the check. At times it is

necessary to reënforce it by supplementary considerations, as in a crying need for exercise or the shame of submitting to difficulties.

The Resolve

Determination with a deferred goal is a resolution. It is an executive provision against the future. Two means of entertainment for the evening occur to me. One takes me up the hill and the other into town. Now I have decided upon the theater and I see myself (image of anticipation) turning down the street after dinner. Unless matters shift during the rest of the day my resolution will be sustained and the theater-goal will be reached, without further interference. These deferred executions are among the greatest achievements of the human psychosome. They lie dormant while other functions run their course, emerging for discharge only when the appropriate setting appears. They emerge in post-hypnotic suggestion of an executive sort, their only peculiarity there being the lack of memory for the original conditions of choice. But in normal waking life, too, this amnesia is frequent; only there we usually hide it by a process of rationalization which provides a specious explanation for our performance.

We should give the determinations of choice more than their due did we not reflect that very many of our acts are the outcome of habitual tendencies, of drilling in by modified repetitions; and not at all the outcome of rival motives. On the other hand, we should observe that human accomplishment goes far beyond that of other animals largely because man is able, by the nature of his anticipative imagery and his more abstract intents, to determine novel performances and so to attain new ends without an indefinite process of trial, failure and modification. But this sort of performance leads us on to the problems of predisposition, which we reserve for another occasion.

In all of our actions, but especially in our choices, we must not overlook the factor of bodily tuning. Who does not know the effects of fatigue, of hunger and of general discomfort upon determination? Religious persecution has often resorted to starvation to break the resolution of its victims. A recent story in *Adventure* of an Alaskan blizzard, in which the traveler was lost for days, portrays the decay under weakness and cold of the determination to exercise and to combat the storm. It now appears that our determining tendencies are also exposed to change and decay through excess and deficiency in the glandular functions of the body. It is probable that a change in the secretion of thyroid or ovary or pituitary will so affect the central nervous system as to depress one whole group or system of determining tendencies and to exalt another.

The Will

Our descriptive account of action should help us to understand what we mean when we say that we "will" such and such an end. The secret of willing lies in the fact of determination. The determination wears a double aspect, as we have seen in the "reaction" experiments; on the one side are the mental structures which bear a prophetic or forward-reaching meaning, and on the neural side is aroused an excitation running a fixed course and serving to give significance to the final stage of the action. "Look for a red square," so the instructions run, "and lift the right forefinger when it appears." These instructions create a determination and by virtue of this determination the red square, when it appears, is apprehended as the thing prophesied in the instructions and also the thing with which the appropriate movement is to be correlated. Now suppose that, instead of instructions so imparted in the experiments, one is determined through choice. The operation is essentially the same, as we have seen; but here the determination may emerge as "my intent."

Deliberation infuses into the final selection the meaning, "this is my decision" or "I will." The determination then operates just as any other determination would, but because of its history we call the act a "willed" act. Indeed deliberation is not always necessary to "willing." Any circumstance which leads to the significance "*my* determination" is sufficient. Thus the application of a rule or of a formula as "the unselfish course is always to be taken" or "good taste requires a polite performance" or "this would be right" may so promptly set up a determination that rival considerations (necessary to a real choice) do not enter the field. At times the individual has nothing behind the stern fiat of his "indomitable will" except some verbal formula, such as, "my way is right" or "this is the command of God" to support his determination.

We may say, then, that any action in which the determination includes a reference to the self is a willed action. Of course, this designation only states a fact, it offers no substantiation for the common belief that, when one wills, a personal agent at the moment rules and dominates the organism adding a power which the organism does not possess. We can easily see that such a belief is extremely gratifying to man's love of power and also that its moral implications are weighty. At the same time we have to acknowledge that unbiased observation does not discover such an arbitrary ruler—one who does not derive his powers from the psychosome slowly fashioned throughout a long period of personal and racial history. At the same time, we see that in determination—the central fact in action—mental structure and meaning play as important a part as neurone and synapse; so we are saved by our psychosomatic function from a description in purely physical terms. It is quite obvious that if we were to remove from action meaning or significance, especially the significance which bears upon the future, we should essentially change its character. We could,

of course, substitute a kind of biologic teleology, as the behaviorists sometimes do, and speak of the organism as "adapting" or "adjusting" itself to conditions by "responding to the demands of the environment." But this procedure has two scientific defects; the concepts of response and adaptation substitute the behaviorist's interpretation of natural facts for the facts themselves, and the method employed ignores that aspect of action which is most amenable to our direct and immediate inspection.

What we do seem to discover, when we project the "willed" actions and resolutions upon the general background of life, is that they mark a distinct advance in the increasing self-sufficiency of the organism. The sponge and the oyster take their setting in life as it comes, directly reflecting in their physiological processes the state of the medium in which they are bathed. The acquisition of receptors, of a nerve-net and a digestive cavity is a long step toward self-determination or "freedom"; the securing of central adjustors and synaptic valves is another; the prophetic and telepathic eye another; the distinction of present, past and future still another; and psychosomatic determination, which includes the organism's past and means "the self," one more important event of the same order in the general history of life.

CHAPTER XIII

THE EXECUTIVE FUNCTIONS: II. THE EMOTIONS

Emotion and Action

The kinship of emotion and action is apparent to every one. In fear we run, we tremble or we fall down; in anger we strike back; in rage we wave our arms or rend our adversary; in joy we dance and sing. Nevertheless, it is common in psychology to distinguish emotion and action as two separate classes. Can this distinction be justified?

Actions are not—as we have contended—"mental states," "conscious processes," or any other kind of existence that can be photographed or inspected. They are characteristic performances which are mediated by the mind-body. They belong to the executive functions. They are determined ways of doing which lead up to and issue in bodily movement.

Emotions also are psychosomatic performances. We do not "have" emotions in the sense of "mental states" or "processes." They are no more "in the mind" than the operations of the steam hoist are a part of the engine, pulleys or crane. Neither are they in the body. Emotions are events. They make particular use, to be sure, of certain forms of experience, notably the constellations and the sense-feelings; and their bodily resources are sometimes distinctive; but as emotions they are operations, occurrences, functional employments.

The primary difficulty in setting off the emotions from the actions is due to the overlapping of the two classes. We have emotive actions, such as the sudden embrace of long separated friends; and we also have action-like emotions, such as those described in the tale of *The Lady or the Tiger?*

and in Elizabeth's signing of the death warrant of her Scottish kinswoman. These emotive actions and these 'active' emotions seem to suggest either that the two functions are identical or that the one class is really a sub-form or variety of the other. The truth is that emotion is just a modified action. The modification lies in two directions; it affects the *determination* and it affects the motor *resolution* of the action.

The Emotive Predicament

First consider the determination. The most obvious thing to be said about the emotion is that it is at once a "seizure" and a "predicament." It is commonly an attack, often unpleasant, upon the organism. This peculiarity of emotion we remark when we confess to being "seized" by fear, "overcome" by grief, "harassed" by uncertainty, "carried away" by rage and "beside ourselves" with joy. Let us scrutinize the matter more closely. First as regards the apprehensive side, we speak of the emotional "situation" and we thereby imply that more than a simple apprehension of a single object is involved. An entire "setting" is apprehended. I am reproached by the traffic officer for bad driving. I suffer anger and chagrin. The "situation" includes the crowded crossing, blocked motor cars, the clang of bells, the rasping voice of the chiding policeman, my unhappy plight, my attempt at justification, and my self-reproach. I am *in* the situation and overwhelmed by it. The apprehensive meanings are at once wide and vivid. The attack from the outside is complex—eye, ear, and other organs of sense are variously appealed to; and inside, the central nervous system, and the autonomic, glandular and motor mechanisms are suddenly augmented in function. Unless I keep my head, the chances favor an interruption of those coördinations which govern the car. I may, of course, continue the train of automatized movements in spite of the emotion. That is to say, I may reserve from the emotional seizure certain

executive functions which serve to remove me from the crowded corner. Even so, the emotion continues its course, only to die a slow death within the next half hour. At the worst I am overcome by a situation calling for executive functions which I cannot command; at the best, I carry through my action-train in spite of the emotion which continues its course and gradually disappears. The tendency of the emotion, then, is to frustrate the determination and so to check the appropriate movements. Whereas the action-determination gradually forms and prepares for its own resolution in movement, the typical emotion, through its general appeal to the organism, replaces or disturbs the determination, which continues then an abortive course to a different sort of ending.

Since the emotion takes this abortive course, at least so far as the determination and its motor sequence are concerned, we may ask why it does not destroy the organism. The chief reason is that those emotions which are connected with the most serious situations or predicaments of life, mating, enemies, care of young and social encounters, release determining tendencies which are very old and stable, which involve the organism at large, and which therefore withstand the shock of the seizure. So the emotional incidents of mating, so the fright and flight before enemies, so the ancient devices for feeding and protecting the offspring, so the give and take between members of a group. Wanting these fixed previsions against the predicament, the organism would obviously be swept away or at the least incapacitated when it is not in a condition to form new determinations appropriate to the moment.

The utility of the emotion, though much dwelt upon, is scarcely a psychological concern. Still we may note, in passing, that on the side of actual accomplishment the chief value of the emotion—at least for human beings—seems to lie in a social direction. The emotion has, that is to say, a signifi-

cance for other members of the group. What we call the "expression" of the emotion chiefly serves the organism itself as a safety valve. The predicament works itself through the organism and is gradually dissipated. The organism is disturbed and must return to a state of equilibrium. Emotions are expensive. They make a heavy draft upon the energies. There may be compensations, as Cannon, Crile, and others have argued in the case of disturbed animals where an increase of adrenin, and other glandular deposits in the blood may momentarily augment the fighting chances; but these compensations would seem to appear in only a few of the grosser emotions which are closely allied to our apprehensive impulse-trains. In human beings, where the predicaments are most complex and most varied, because of the ideational resources of man, the chief value of the expression is certainly its indication of the state and temper of the individual as realized by others—by those others for whom the emotion is significant because they too have been in predicaments and have been "moved" in a similar way. The complex life of the human group would not be possible were the individual unaware of the way in which his fellows are moved. To be sure, certain levels of culture demand a repression of many of the emotions; but then these peoples defend themselves by rules of conduct, by verbal surrogates for the primary expressions, and by providing religious, literary and artistic avenues of expression. How important a part emotions play in the group we shall further observe in our sections on social psychology.

Leaving out the intermediate functional forms, then, we may say that whereas the action is characterized by a determination, discharged in due course by movement, the emotion is characterized by the predicament—a situation in which the individual is so involved as to call for a resolution. Our chief task in emotion, then, is to study the predicament and its sequel.

The Functional Treatment of Emotions

Nearly every psychology attempts to classify the emotions; but, like most classifications, the emotional species and varieties furnish dismal reading. No single classification has ever been generally agreed upon; in part because the experimental study of emotion is in a backward state (we have no adequate description of the factors involved) and in part because it has been easier to discuss theories and especially biological theories of the origin and the use of emotion than to distinguish its kinds. When we agree to regard emotions as functional modes we limit our classification to varieties of performance, just as we did in action. We have, then, to discard such logical schemes as "objective—subjective," "self-referring—other-referring," "selfish and social"; and neither can we derive emotions from a few hypothetical instincts which are taken outright from biological speculation or from casual observation of other animals. If we shifted our conception and found the core of emotion in certain sensory components, as the original James-Lange theory assumed, we could classify as visceral, thoracic, and circulatory, or as straining and relaxing, agreeable and disagreeable, exciting and subduing. These classes seem, however, to touch either upon incidents in the emotion or upon hypothetical origins rather than upon the varieties of emotive performance itself.

To understand the emotion and its varieties we must keep in mind the two large types of function which we have already examined, apprehensive and executive. Both stand closely related to our present task. First, no emotional situation could be created without apprehension. We notice that *A* smiled in a supercilious way when we expressed an opinion upon a certain matter, that *F* ignored us upon the street, that the motor car was making directly for the pedestrian, that the sky was clearing in time for our outing, that *M* pre-

ferred the society of *T* to our own; so resentment, humiliation, horror, joy, jealousy. Apprehension then plays its necessary part: it presents the scenery for emotional enactment. But it is not always of the perceptive kind. You are stirred with wistful longing when you remember "better days," with anger when you recall the insult, flushed with embarrassment over a remembered gaucherie. Again emotions are engendered where the apprehension takes one of the imaginational forms. Anticipation stirs, reveries thrill, and the creator of a work of art suffers and rejoices before his fictitious object. In all its forms, then, the apprehensive kind of operation contributes to the emotion. There are two or three things about it, however, which make it especially appropriate to the emotive setting. The extent of the apprehension we have already remarked. Not a single object but a whole "situation," with its internal relations, is apprehended. Again, the situation is dramatic. It is more than scenery. It works: it is dynamic. The persons and forces are aggressive; they insult, injure, comfort, aid, misjudge and misinterpret. This aggressive dynamic character of the apprehension is due in part to its hallucinatory character—even in the remembered quarrel or the imagined love scene there arises the illusion of a vivid presence—and in part to the affective coloring which overlays, and is fused into, the apprehension. This dramatic presence serves to convert the situation into a predicament, into a problem calling for solution. Once more, the situation usually involves the individual who apprehends it. He is a part of its meaning. The fearful object threatens him, the insult touches him, he is grief-stricken or pitiful, resentful or jealous. Where the observer is not himself made a dramatic part of the situation (as in an accident beyond his power to aid) the situation nevertheless seizes him and so demands a resolution. Finally, the apprehensive side of the emotion is (at least usually) of the *symbolic* kind; *i.e.*, its meanings are secondary or derived.

The reference stands at two removes. The directly apprehended objects stand for, symbolize, something else. The uplifted arm means "intent to injure," the raucous voice that the "other person is irritated," the blue sky that "nature smiles upon our outing" and the collision on the street means "death" or "suffering." This symbolism is of a valuing, appreciative sort. Through it we empathically inject into the scene our own feelings and thereby enhance its dramatic character.

We cannot complete our account of the emotion if we stop with the apprehension, for emotion is more than the setting forth of a situation. We have spoken of the aggressive, appealing aspect of the emotion, the aspect which converts it into a predicament. The situation makes a demand; it represents a need. But instead of a determination which issues in an appropriate movement, as in action, the emotion is resolved in a different way. In action the need progresses toward satisfaction under the guidance of a determining tendency. Not so in the emotion. Here lies the nerve of the distinction. In emotion appears a problem which is not immediately soluble through movement; a dramatic situation which is not removed by a thrust of the fist, a turn of the body, or by any delicate coördination of eye and hand. It is not that sort of a problem. In terms of the executive functions, a determination is called for; but no adequate determination, none fitted to the problem, arises.

What does arise is a general organic crisis which varies with the character of the apprehended situation and varies also with the history of the organism. So we find unlike seizures for rage, grief, joy, resentment, fear, and other more pronounced emotions; and we also notice that the crisis somewhat varies in the child and the adult, the adolescent and the senile, the European and the Hindu, the Nordic and the Latin. Cannon concluded that the physiological mechanism was essentially the same in the various emotions; but Cannon's experimental observations were chiefly confined to

visceral changes in animals under operative conditions whose state superficially resembled a terrified fear or rage in man. These changes chiefly concerned heart-beat, peristalsis, contraction of smooth muscle and glandular secretion. There still remains the possibility of other factors in these and in other emotions, of differences in degree, in pattern of integration, and in various modes of somæsthesis. Even a superficial observation will discover gross differences in the bodily "feel" of postures, grimaces, and attitudes which are set to simulate fear, fighting anger, grief, cunning reprisal and amorous conquest.

We do not suggest that the reflex or automatic bodily changes are the emotion. The strongest adherent of the James-Lange theory would no longer so contend. It is nevertheless clear that the organism does undergo complex changes which vary, at least in part, from emotion to emotion. Our apprehension of emotion in others, through mien, gesture and other modes of "expression," as we say, testifies to this bodily diversity. These complicated organic changes represent in the bodily vehicle the specific problem which confronts the individual. Whether or not they are decipherable as real "expressions" of emotion is a question of great biological but small psychological significance. The fact is that they represent the bodily side of the emotional problem at a certain stage, a stage which we call the crisis because it suggests, on the mental side, an integration which means "here is the predicament." What the central physiology of this stage is we know very inadequately. Bain spoke of a wave of diffusion or overflow. Whether the brain is surcharged with energy which suddenly breaks bounds and floods the central nervous system we cannot say. There are evidences that the central functions are at least widespread, and that instead of the release of a specific determining tendency, which would lead on to a motor issue in action, the organism resigns itself, so to say, to an insoluble

problem, vainly uses a wide variety of resources, and only gradually returns to a settled state of function. There can be no doubt that a large part of the difficulty which psychologists have always encountered in attempting to analyze emotions arises from the prominence in these baffling phenomena of the unanalyzable "vital" or "indicatory" aspect of experience. The seizure means an interference with the general progress of life, with those processes of metabolism, secretion and so forth which generally incline and temper the neural functions and which appear in experience as "feeling" and as the thrust of desire.

Classes and Varieties of Emotion

If we follow historical precedent, we may distinguish the emotions in various ways. The most obvious way is to search casually through experience and set down as many striking "emotional states" as we chance to find; thus love, anger, fear, sentiment for property, enjoyment of power, pain of subjection, pride, vanity, æsthetic emotion, moral sentiment, etc. (Bain). Such a catalogue is about as valuable to psychology as the truck-gardener's list of crops would be to the systematic botanist. A method of classification widely used of late is the historical or evolutionary method. It refers each "primary" emotion to a corresponding "instinct," which it assumes to be original and underived. The instincts are usually selected and named to correspond to the common names of the emotions; thus fear from flight, anger from pugnacity, wonder from curiosity (Ribot, James, McDougall). This method is speculative, not empirical. It seeks the causes of emotion in vaguely defined general forces with which the organism is assumed to be hereditarily endowed. In the second place, it is a theory of origin instead of a description of the emotions. And, finally, it fails to do justice to the vast variety in emotive coloring to be found in the experience of man. A related mode of classification re-

fers to the end toward which the emotion moves, *e.g.*, bodily preservation, racial preservation, social welfare, and the like (Mercier). Into this sort of teleology no psychologist should be tempted to enter. A basis of distinction which lies nearer the psychologist's observation of the emotions rests upon the course of the feelings displayed in the emotion and the composite or resultant feelings which appear. Thus Wundt distinguishes such emotions as rise quickly and fall slowly (*e.g.*, surprise at a sudden loud sound) from those which rise slowly and fall quickly (as hope and sorrow), and so on. This description in terms of the temporal course fits admirably into Wundt's doctrine of the simple and the compound feelings; but it takes account only of certain affective and organic constituents in the emotions. Titchener makes the doctrine somewhat more plausible by reading "sense feeling" for simple affective process; but "agreeable-disagreeable" scarcely touches the essential difference in joy and fear, nor does "exciting-subduing" express the difference between anger and grief.

The names which we commonly bestow upon the emotions are "meaning" names. They serve first to characterize the predicament in terms of common sense. Thus "fear" indicates that "here is an object or state of affairs which threatens"; anger that "this act or attitude must be protested," joy that "this turn of events brings what I want," jealousy that "this person receives that which I desire," and so on with the others. The names serve, secondly, to characterize the gross attitude of the individual towards the predicament. On this side, fear means "a shrinking, retreating, panicky condition under threat," joy means "the feel of triumph and celebration," and jealousy "defeat under competition." As regards the resources, both bodily and mental, which are drawn upon for those functions a great variety presents itself. On the bodily side, as we have seen, skeletal muscles, glands, and the digestive, circu-

latory and respiratory apparatus, as well as the brain, are involved. On the mental side must be included the patterns from outside stimulus and the complexes which run directly with the bodily changes; while any other present phase of experience may be made to serve both in the representation of the predicament and in the attitude of the individual emotively seized.

No classification which attempts to catalogue the emotions by enumerating the predicaments can be satisfactory to the psychologist. That attempt would be like listing the parcels in the picnic basket to arrive at a classification of their dietetic ingredients. Even the distinction based upon the organic state, the posture, or the expression touches only individual factors and accessories. A moment of terrible suspense may be followed by cardiac palpitation and general weakness; an insult by a respiratory stuffiness. There is the cold sweat of terror, the intestinal "sinking" in dismay, the thrill of goose-flesh, the muscular spasm in agitated uncertainty, the hopeless misery of effort under a "nervous" fatigue, and the swimming dizzy loss of balance when the last straw of trouble finally causes a general collapse. But these are all incidents in the seizure of the organism.

Since the emotion is for us essentially a mode or way of functioning, our own problem of classification concerns this manner rather than the items which enter into its formation. Nothing like a definitive classification is to be thought of at this time. In fact it is doubtful whether sharply delimited classes or species of emotion exist. All that we can attempt to do is to scrutinize the emotions in course, indicating the various ways in which the predicament is formed and then resolved or destroyed. To this end, we shall do well to keep constantly in view the functional likenesses and differences presented by what we may call the complete and typical action and emotion. The similarities may be exhibited in the following way.

Stages of the Complete Action

(1)		(2)		(3)
Formulation of task	>	Progress of the determination	>	Resolution through movement

Stages of the Complete Emotion

(1)		(2)		(3)		(4)
"Dramatic" situation	>	Seizure	>	Attempts at resolution	>	Resolution by decay and decline

Our emotive varieties should, then, represent modifications in the course of these executive functions. We shall distinguish a number of them.

1. *Emotions with Complete Want of Resolution*

Here the predicament resists every attempt at solution. Every incipient determination ends abortively. The organism is helpless. The diffident boy is suddenly called upon for some small service in an observant group of his elders. He sits and gapes. He shrinks from being conspicuous. He does not seem to himself to be the appropriate person to discharge the task. Still, he dislikes to be unobliging. He would like to explain. How can he? He grins and blushes. He cannot speak or rise. The task is impossible; so he miserably fidgets and suffers. Under other circumstances, the irresolvable predicament may take the meaning of anger, as from an unexpected taunt or insult where taste or manners forbids a public protest. Again the individual is helpless. Shame from a public exposure may take the same course. Here the predicament paralyzes the organism. Nothing can be done at the instant; although the situation calls for resolution. In these cases the somatic effects are both widespread and intense. Smooth and striped muscle, gland and viscus are innervated. The bodily commotion is violent. The actional functions have failed, for no determining tendency has succeeded in running its normal course. The

result is a gradual dying out while the organism nurses the predicament. As a rule, failure means a crisis and after the crisis the seizure begins slowly to subside. It is apparently this abortive course of the emotion which has led to the theory of "blocking."

2. *Emotion with Incomplete Resolution*

Instead of an initial helplessness, the situation may release a determination which, however, fails before it is completed. So resentment at a boorish action sets up in the nervous system a determining tendency which clenches the fist and starts a verbal reproof; but the necessity of repression extends the predicament, cuts off the determination half formed, stays the hand or the tongue, and leads to a general somatic excitement which induces the crisis. A gradual subsidence, instead of an appropriate movement, finally completes the emotion. The inhibitions of custom and manners often give our emotions this appearance of frustrated action.

3. *Emotion Following an Automatic Determination*

Walking in the suburbs I suddenly find myself giving a startled jump into the air. The body is twisted to the right and the head to the left. A bicycle silently passing has turned upon the dry grass to avoid me. It is as if I had jumped to escape a sudden rustling in the grass; but the apprehension of the fearful object comes only after I have lifted myself off my feet. Before the apprehension fully develops, however, it is corrected by the sight of the speeding wheel with its amused rider. There is no doubt of the emotion of terror with extreme unpleasantness; although it appears after the automatized movement has set in. Here we have an instance of the intermediate half-action-half-emotion which exemplifies the close relationship of the two kinds of executive function. An old determining tendency which leads on to the startled jump forms before the apprehended situation arises;

and the automatized action is so far under way that the delayed predicament does not interfere with it.

Psychologists have been inclined to see in these seizures with automatized movements evidence of the racial or instinctive roots of emotion. This view is speculative. It is more likely that these sudden recoils and defenses have been transformed and adapted, as in the case of Watson's infants, from a more primitive sort of spontaneous movement to the varied "situations" of the individual life. When these acquired automatisms have been allowed for, it is likely that a few simple determining tendencies of racial origin will be left over; but we are not justified in looking to instinct for the origin of the great number of emotional seizures which overtake the human organism.

4. *Emotion Resolved through Action*

Nothwithstanding the resistance of the emotion to a speedy resolution, we all know occasions upon which an action may be imported for the express purpose of clipping short the term of the seizure. A stock example, popular in lurid fiction, is the evaporation of hate or jealousy through murder. While some men hesitate to employ such an heroic measure for relief, we all use the same device when we vent our spite by kicking the defenseless chair which has painfully startled us in the darkness. In these decapitated emotions the action cannot be said to be an incorporate part of the seizure itself. Rather it is an outside device which succeeds by destroying at one blow the predicamentive occasion.

5. *Emotion with a Train of Active Incidents*

The relation to action is still more intimate in those emotive situations which include a whole series of performances. Certain "parental" emotions are of this character. The center of the situation is the infant. The mother is solicitous for its care and comfort. During the course of a single

emotion of this kind the movements necessary for bathing, feeding, dressing, holding and embracing may run their course. In the emotion are embedded a chain of determinations which issue in sequence in the several actions. So, in fighting, a sustained anger or fear may lead to a train of offensive and defensive movements. The enemy is struck, dodged, tripped and thrown; but still he is "enemy." The expressions of joy, as in the sudden encounter with an old friend, may likewise occupy the same place. Here the emotion is primary; the several actions secondary and incidental. The primacy of the emotion is shown by the fact that the predicament continues in spite of the action-train which sustains instead of resolving it.

6. *Emotively Toned Actions*

Many of our common executive functions wear the plain aspect of action, *i.e.*, they display determinations which work themselves through to appropriate movement and nevertheless they are emotionally toned. In vigorous labor under obstacles the hint of a predicament charges us for the task. We must finish the job, though it taxes our resources of skill and strength. Whenever we "wrestle with nature," conquering and subduing as we go, our performances are apt to present this emotional coloring. The predicament sustains our interest, keeps us on our mettle, and so invests the daily task with vigor and enthusiasm. Again, artistic production, in so far as it involves execution, gives rise to this sort of emotive tuning. The proposed picture or sculpture is a predicament which the artist works himself through, under the glow of the kindling emotions of perplexity, admiration and joy.

7. *The Transformed Emotion*

There is one circumstance under which the emotion fails to end by a gradual decline. That is by the arousal of a

new predicament. Here we find two cases. In the first, an incompatible emotion is kindled while another is in course. Then the first is subdued and checked. We all use the device of killing one emotion by another. The parent supplies a novel form of entertainment or a familiar form of punishment to distract the child from his sorrow, disappointment or sin. If nothing is at hand the child is promised a holiday, a present or a whipping, which he is urged to anticipate and so to "forget his trouble." His elders likewise seek out for themselves agreeable forms of entertainment or of dissipation to destroy worry or unrequited love. Since the predicament of any emotion engages the organism in a general and absorbing way, it does not countenance a rival. Mental therapy makes good use of this principle of replacement to root out emotive trends which are too insistent or too exhausting. Emotions which reach out to irrelevant matters and so consume the individual for hours and days together are unhygienic. A worry or disappointment, for example, which gains control of many associative and determining tendencies, irritating the brain and gnawing at the autonomic vitals, while it runs a long and violent course, is inimical to health.

In the second case, the change may be resident in the emotion itself, which shifts and changes instead of being replaced by another. What we call "relief" is really the resolution of anxiety, dread or despair. The forward-looking, anticipatory emotions are very likely to present this phase at the stage of resolution. I am anxious over an approaching operation. The anxiety turns to relief upon good news from the operating room. I dread an examination in history and I am relieved when it is over. In a similar way, joy may turn to anger, if the source of the joy is suddenly cut off. Even the good intentions of a friend who seeks to distract us from our sorrow may lead to resentment, if not to anger. Thus

obstruction or frustration during an emotion, as well as its resolution, may lead on to a new emotional phase. These emotions which pass through successive phases have been called "temporal"; but all emotions are temporal, because they all are functional operations which run their course. Another way in which the emotion shifts is by way of a change of attitude while the predicament remains. In Conrad's *The End of the Tether,* the ship's mate jealously hates the calm and dignified master of the boat; but later he gleefully regards the same man when he discovers that he is blind and helpless. Lady Montagu, suffering a keen disappointment over the failure of a correspondent, first falls "into a vexation, and from thence into a chagrin, and from that into a melancholy, with a complicated et cetera." In a similar way anger may turn to hatred when the object proves to be invincible and hope to despondency where courage fails. A shift in the meaning of the predicament leads to a change of coloring in the emotion.

At times a serious and enduring situation may set up, not a single shift, but a long cyclic series of emotional changes, the whole revolving about the unescapable predicament. We have all seen defeated men brood for months over some emergency which proved to be beyond their powers. They constantly advert to the matter in memory, examining it on its various faces and circling about it with emotional attitudes, regretting, then hating, then justifying, then excoriating, then sorrowing, only to come back to the first phase and so to run again through the entire cycle. When these predicaments touch the springs of life, threatening the economic, social or professional standing of the individual, they may become, if unchecked, very serious, leading to permanent impairment of the psychosomatic functions. Failure in business or in a profession, excessive grief with remorse, loss of reputation, and the crises of battle, are productive of these vicious and dreadful emotional cycles.

The term "predicament" seems to suggest that emotions are always unpleasant. Most of them are. Take a representative list of them: anger, rage, fear, pity, resentment, jealousy, envy, grief, hope, hate, despair, joy, remorse, shame, disgust, relief, lust, anxiety, disappointment. Only hope, joy, relief, lust, and certain forms of anger suggest agreeableness and pleasure. Of these we may say that relief is but the agreeable resolution of emotions unpleasant in their earlier stages, *i.e.*, anxiety, fear and despair; that anger is pleasant only when it is in process of resolution, and that hope is only hope when the predicament presents unpleasant possibilities. We are left with joy and lust. From joy we must subtract the joyful and playful moods (without predicament) and the joyful resolutions of a wide variety of unpleasant predicaments (the most frequent joys); and from sexual and amative emotions those frustrated forms which are distinctly unpleasant. We are still left with the real stir of desire before its object and the joy which inheres in a really "joyful" situation. But it may be doubted whether joy is a real emotion. There are joyful occasions. But are there joyful predicaments? Shand argues for a kind of predicament or "end" in joy, an end which he finds in the effort to maintain the joyful occasion, "to conserve the existing situation," to prevent it from lapsing; but it is doubtful whether this is an inherent part of joy itself. Where joy is not a case of exuberant spirits, a mood sustained by agreeable apprehensions, it appears essentially to rest upon unimpeded action and accomplishment, as in play, exercise and the dance.

Some of the phases and situations of love fulfill the conditions of a pleasant predicament, the pursuit of the loved object and amative play. Here desire in suspense, combined with some form of the apprehensive functions, furnishes the predicament, and bodily reverberations supply pleasant somæsthesis. But even in love, a large part of the pleas-

ant emotion belongs to the stage of resolution and not to the original stage of the predicament. The various forms and incidents of love should warn us against confusing a single emotion with a fixed attitude toward a person, object or institution, which may supply the individual with a long and varied series of separate emotions. Affection, whether for mate, child, or friend, may yield, according to circumstances, hatred, jealousy, resentment, fear, anger, and sorrow. Almost as many emotions may be derived from a cause, a party, or a principle, according as one expounds, defends, doubts, or loses it. In fact it is questionable whether any object or matter which is capable of furnishing one emotional predicament is not also capable of furnishing others. These varied emotional resources, which Shand calls "higher systems" or "sentiments," have important social values, as we shall presently see; but they add little to our knowledge of the emotive functions themselves.

Emotive Episodes and Trains

We should not do justice to the full score of emotively inclined experiences were we to omit reference to the *emotional episode* and the *emotional train.* A greeting upon the street or the handwriting upon a letter in the post may induce the emotionally toned episode; and an hour's social call, the delivery of a lecture or the attendance upon a concert, may establish an emotional train. The peculiarity of these states is that they are devoid of execution, and they cast only the shadow of a predicament. Nevertheless there is an affective unity about them which suggests the emotion. In the episode, we have a highly socialized apprehension. The implications of the greeting dispose the entire organism. The individual glows, frowns, or condescends. Of course, the incident may develop a real predicament ("How shall I preserve my dignity?" "I certainly hate him!" "Is it too late to dodge?"); but we now consider those cases where

it does not. In the emotively tempered train appears an entire "topic," which we shall better understand when we come to the section on comprehension. An extensive mass of material is bound together into a single subject. Those who speak in public know the emotional phases of the address; the plodding rise of the first minutes, the invigorating swing of exposition, the thrill of engaging the audience and the lassitude of the end. The auditor, likewise, at the symphonic concert may sustain a similar emotional train, bearing its own characteristic phases. It may be these episodes and trains which have fixed the common belief in agreeable emotions. Stir, thrill, enjoyment, pride in accomplishment, the lust of personal influence, and the like—common meanings of the episode and the train—are undoubtedly conducive to pleasure.

Emotive Inclinations

The intrinsic relation of emotion to action has been observed. The bodily apparatus for movement is involved in both. But in complete emotion the determination is either wholly inadequate or it fails to complete itself as it does in the action. Again, feelings are much more prominent in emotion than in action; though this difference is rather of degree than of kind. Lacking full determination, the emotion nevertheless has its springs, and it runs, as action runs, a "dynamic" course. While we dispense with "mental forces" here and elsewhere, we have to admit that the organism is variously and actively attuned to emotive functions. The predicament is therefore not passively suffered. It is rather in the organism than in the objective play of circumstance. That is to say that the organism is so primed and inclined that a given situation becomes a predicament. One and the same scene or person may precipitate a passionate crisis in a lover, a gust of hatred in a business rival, envy in the victim of misfortune, and fear in the timorous.

These individuals are differently inclined and so create different predicaments out of the selfsame encounter.

The inclinations stand to the emotion much as the determining tendencies stand to the action. They supply the springs. In the normal, governed individual they precipitate a crisis only upon suitable occasions. The individual is angry, fearful, jealous, grieved or joyful as the occasion suggests. The "occasion" cannot, of course, be considered apart from the private history of the person seized and from his relations to the exciting object or event; but his emotional inclination is conformable to his circumstances. Where the inclinations are excessive, one-sided, or unbalanced by opposing inclinations, the individual is emotionally erratic. The hasty man flies into anger upon any pretext; the coward is habitually inclined toward fear; the sentimentalist makes predicaments where only cool matters of fact are presented; and the melancholic person falls readily into despair and discouragement. These emotive springs are important for "character." They determine not only the emotions. They also affect, through their influence upon the determining tendencies and prevailing interests, the individual's actions, thoughts, and general outlook upon life. They are derived both from the individual's past, being commonly affected by health, sickness, success, previous crises and habit, and also, as it appears, from hereditary and constitutional tendencies which survive the single generation. Where the prevailing emotive inclinations of an individual are pronounced and persistent they are spoken of collectively as "temperament."

Mood

Since the emotions represent, so to say, the tempering of the whole individual in any given crisis, we might expect that something like them would appear even where no situation forces a predicament. We do find something like them, as a matter of fact, without the predicaments, and then we

know them as moods. The irritant mood only needs an occasion to precipitate an "angry" explosion or a resentment; the timorous mood, terror; the jovial mood, joy; the melancholy mood, sorrow. Underlying the mood is a fixed inclination which is not wholly dormant; an inclination which colors the whole stream of experience, deflecting the associative, determining, and habituational tendencies, and directing and diverting the psychosomatic functions. A coöperative study of these moods in the writer's laboratory has revealed an enormous variety of them, half a hundred of them being reported by six observers. It appears that these moods were present during a large part of the average day; and that they were due to, and were sustained by, digestive processes, general kinæsthetic tone, intercurrent emotions, work, recreation, sleep and sleeplessness, personal encounters, fatigue, and many other factors. It is in mood that we find most vividly exemplified what we have called the "vital indicator." Mood registers the ebb and flow, the rise and fall, the hurry and retardation of life. Moods do not present objects and situations: they are gauges set into the organism. It is not by accident that our salutations "How do you do?" "*Comment allez-vous?*" and "*Wie befinden Sie sich?*" advert to these registrations, or that our small talk should constantly bear upon vital subjects. Health, our "feelings," our glandular balance, our digestive state, our muscular tone, our reserved energy, all are registered in our moods. Only the personal affairs of his neighbors and of the eminent can rival the absorption of man in his own intimate state of being.

It is inevitable that a phase of psychosomatic function so closely related to the ebb and flow of life should suffer in mental disorder, and it is significant that the classical disorders of "melancholia" and "mania," reflecting by an uncritical designation the most obvious swing of mood between elation and depression, should have played so important a part in the history of "disorders of the mind." Even in re-

cent books on psychiatry the group of "manic and depressive" disorders is one of the most prominent. Only the psychology of wish and desire has given a secondary place to these aberrations of mood. Again, we shall discover, when we come to study the socialization of man, that the interplay of men in groups is largely determined by mood and by the more permanent affective trends of disposition and temperament.

Need and Desire

The medical studies of the French psychologists, the classical writings of G. H. Schneider on the actions, and the evolutionary accounts of instinct have improved our understanding of desire, impulse, and appetition. These subjects have attained still greater prominence in the systems of Freud and his followers, who have added the concepts of the "libido," "conflict," and the "unconscious." Out of them has come an elaborate explanatory system which has been applied to many of the problems of psychology and of medicine. Here we need only notice that desire, called by Schneider *impulse* (Trieb), by Freud *libido,* and by the evolutionists *instinct,* has frequently been made the root of the inclinations and so the spring of emotion and of mood. While we have recognized the needs of the organism, which are always pressing for fulfillment, and the wide dependence of the emotional predicaments upon these active vital appetitions, we are not thereby committed to the doctrine of the unconscious or to such an impersonation of forces and faculties as we find in the speculative psychology of the psychoanalyst.

CHAPTER XIV

THE COMPREHENSIVE FUNCTIONS: UNDERSTANDING

Two great psychosomatic functions have served the animal forms of life from a very early time. They are apprehension and execution. The main form of apprehension has been perception, *i.e.*, the use of sense and movement organs, nervous system and mental qualities in "knowing" present objects and present occurrences. This is one of the first concerns of a creature which subsists by making terms with, and by modifying, the outside conditions of life. The chief form of executive function has been of the impulsive sort, wherein the organism is immediately determined upon the perception of existing objects. The determination may be in part racially set or wholly integrated out of the experiences of the individual himself. From the amalgamation of these two functions, apprehensive and executive, undoubtedly came, at a fairly early time, the crude predicament and the simple emotion.

Except in the forms most closely related to man, the psychosomatic functions of the organism have gone little further. It is only when the imaginal processes came into being, enabling the creature to devise meanings beyond the present time and the present place, that new functions began to prosper. Perceptions became richer in meaning; memories and anticipative imaginations appeared; action became more complicated and less closely bound to the present moment; and emotion was extended to new situations by the advent of far reaching predicaments.

But beside these functional extensions which we already

know, we have to observe the appearance of new operations—the functions of understanding and thinking.

The Difference between "Thinking out" and "Thinking about"

In our common speech we use "thinking" to cover two separate matters. We "think out" our problems in business and in the study; but we "think about" the fine weather we are having, the prevalence of chicken pox, the price of grain and lumber, the probable outcome of the elections, and business engagements for the morrow. Here is a functional difference. True thinking is elaboration, *i.e.,* it is conceiving a problem and elaborating or working it out, by certain means, to a conclusion. We think out the demonstration of a geometrical theorem. We reason through the reactions which occur when we test by known reagents our unknown chemical compound and come upon its constituent parts. The detective observes his details and thinks out the probable history of the crime. The director of the weather bureau makes a problem of barometric pressures and temperature gradients and thinks out the weather for the next twenty-four hours. In real thinking there is always a problem proposed (a "thought" problem) and a solution attempted. How the problem is resolved we shall see in due time. Against this true thinking we have now to set the "thinking about," which we shall call comprehension or understanding—a much commoner exercise of function than thinking is.

Comprehension and the Topic

The key to comprehension is the topic. The topic corresponds to the predicament of the emotion, the determination of action, and the object of perception. We "think about" or comprehend topics. Weather, disease, price, elections, and engagements are topics. The intelligent person of ordinary personal and intellectual interests is constantly engaged upon

topics. We may, of course, make thought-problems out of topics; but as a rule we do not. By far the largest part of education is made up of topics. The history lesson and the relation of the participial ending to the subject in French are topics; the present page presents the topic of understanding; the lecturer in physics discusses the topic of liquid air or of gravitation; and so on. Topics are handed on from teacher to pupils, and from book to reader, from apparatus to experimenter. Even in what is known as study, "thinking about" or comprehending is the rule; real problem-solving the exception. Let us examine our "topic" and see what is involved in this mode of mind-body operation.

The entertainment of a topic involves the creation of a peculiar kind of meaning. The topic is not an apprehended object; it is a comprehended subject. All sorts of objects may be involved in it. At this moment, with the sun nearing the meridian, my topic is "hunger." I "think about" my approaching luncheon, the putting away of my work; I visualize the luncheon table, the linen, the salad, the coffee; I dwell upon the literature of hunger, the researches of Cannon and Carlson, and the words "food for thought." The topic is obviously created and sustained by a mass of associative materials. Although the neurologist is unable to tell us the nature of the central nervous processes which are involved in creating topics, we may provisionally speak of them as proceeding from "topical tendencies"—in analogy to the determining and the habituational tendencies.[1] We know that the brain makes its contribution to this function; that it is so disposed as to reënforce certain "relevant" associative tendencies (as in the case of selective action) and to inhibit others. But the rest of the body also makes

[1] We have no reason to believe that the topical tendencies are different in kind from the reproductive tendencies. We may regard them as *connective associations* (von Kries) among groups and clusters of individual reproductive tendencies.

a contribution to the topic. At times a receptor is pressed into service, as when some visually or auditorily apprehended object is used as a stable representative of the topic. Thus when I proposed prices a moment ago as a topic, I had before me the market page of the morning paper, and the "hunger" topic was typified by the sound of feet homeward bound upon the walk outside. Here the apprehended object is not so much an object as it is a concrete surrogate for, or representation of, the topic. Again, the organism is clever in its use of postures, strains, and attitudes, upon which it builds its topical constructions. Fortitude is much more vivid and permanent when I set my jaw and straighten my spine; "time" is clearer when I suspend my breath, as if listening to something which passes; "trouble" literally feeds upon a frown and the feel of a dour visage, and "industry" upon a vigorous fumbling with the pen and a fixed stare at the paper. When present objects, movements, and postures fail us, we have recourse to shreds of imagery for our topical representations. At the moment, the topic "labor" is typified by the familiar arm-and-hammer figure held in free image, and "peace" by the white dove and the suave cadence of a demagogue's persuasive voice. These shorthand and symbolic presentations are especially useful where the presentation is brief, lacking opportunity for a train of explicit imagery to expand the topic on its various sides.

Another resource is the mood. James remarked that it was impossible for a vigorous youth in abounding health to dwell upon the topic of death and of his own tomb. Cellini, half starved in prison, had visions of ministering angels and of heavenly feasts. The melancholy dyspeptic proverbially turns to lugubrious subjects, where the jovial man naturally adverts to topics of cheer. Not only does mood strengthen the individual associative tendency, as we have observed; it also sets and encourages whole topics which are congruent with its temper.

In speech, topical discourse is enormously extended by verbal symbols. The mere name of the topic, where it has a familiar ring, is sufficient to start the comprehensive functions. The art of conversation demands that words shall carry a topic of common import to speaker and hearer, the hearer clothing and enriching it by his own psychosomatic resources. The art of developing the topic in conversation is beautifully displayed in the classical *Dialogues* of Plato. The skillful lecturer avoids the necessity of too much thinking in his auditors. Instead he develops topics with sufficient deliberation for each hearer to provide his own assimilative filling. The speaker must not forget that some hearers are obliged to translate his verbal symbols into other forms before the topic develops for them in a significant way.

Language and Comprehension

The primary function of language seems to have been the transfer of topics from one individual to others. Objects can be visited, inspected and used; actions must be developed by each individual from his own determinations; and emotions are, in a sense, private predicaments which are privately suffered and resolved. But the topic is something current. It belongs to a group of individuals living under common conditions. Language is its vehicle, its medium of exchange and of communication. We speak the literal psychological truth, then, when we say that we comprehend what is said to us and what we read from the page. The word, the phrase or the sentence touches off a topic which is further rounded out in the conversation the lecture, or the essay.

This suitability of language for comprehension is dis-

---

[2] Language has acquired a second large use. It supplies symbolic means for the solution of thought-problems; but this use we reserve for a later discussion.

played in its structure. The sentence is the smallest formal unit for the communication of a topic. "The Emporium announces a special sale," "The government has sold its wooden ships," "How each of the cities, New York, Chicago and Boston, loves its own provincialism!" "The study of philosophy sometimes engenders conceit in the young," "How is law related to morals?" "If nations were to become wholly selfish, we might expect war to continue," etc. When occasion requires, the formal sentence is condensed into an exclamation ("Fire!" "Look out!" "Help!") or into a title (*The Decline and Fall of Rome, The Last of the Mohicans, The Red Badge of Courage, To-day's Markets*); but it is still, so far as the topic is concerned, a sentence.

In written composition, larger topical units are formed by the paragraph, the section, and the chapter. Then each sentence plays a subordinate part in developing, elucidating, and qualifying the topic. The clever speaker likewise groups his sentences, announcing his several topics, setting them off by pauses, by emphasis and inflection, and by shift of position. The art of expository and informative address consists in the simple and clear communication of topics in their appropriate order. It wants the dramatic appeal to the emotions and convictions to be found in the oration, the recital and the play; for its appeal is rather to the comprehensive functions.

So firmly have we connected verbal signs with their meaning that we often regard words, when spoken or read, as themselves containing their topics. As a matter of fact, of course, they are—so far as the organism is concerned—first stimuli appealing to the ear and the eye and then physiological change and mental structure. The meaning, which is the topic, is the end and outcome of the comprehending function. It is every time created; not, as we loosely say, directly communicated from mind to mind.

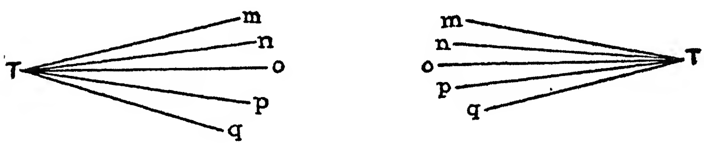
The production of topical significance through reading

is a complicated matter, more complicated than the listening to speech, where meaning is often directly attached to the sounds. Reading has been made the subject of many experimental studies, which have been especially addressed to rate and accuracy. The records of eye-movement, as the gaze follows the line across the page, have made it evident that the creation of meaning depends upon a selective process. The eye jerks along, fixating here and there a group of letters, the others being either apprehended in indirect vision or not at all. The topical meaning is produced out of a complex of clear and obscure visual configurations, rapidly shifting and of short duration. In the "eye-reader" the meaning comes directly with these visual patterns and the accompanying neural and motor changes. In the "ear-reader" or "throat-reader" sounds or vocal contractions are first produced and only then does the meaning appear. Apart from a host of outside conditions (type-face, illumination, leading, length of line, and what not) comprehension depends upon the readiness with which whole constellations of associative tendencies are made actual; depends—so far as the central nervous system is concerned—upon what we may vaguely call "topical readiness." What the want of this readiness means we realize when we open a book in a language only slightly known to us. So far as experience itself is concerned, comprehension is obviously much more economical than the apprehensive functions; for it is the rule (especially in reading and listening) that elaborate and complicated topics are carried by slender threads of quality and by simple integrations. Here the body obviously carries more than its share of the functional burden.

Comprehension and Learning

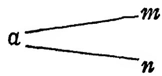
Comprehension or understanding is a kind of acquisition in the sense that when we comprehend we either form new topics (*e.g.*, new knowledge of the chromosomes or a first

acquaintance with the geological periods), or else we enrich or modify old topics—a much commoner form. In both cases the materials come in what we call "topical formations." Sometimes the materials are supplied in perception, as when we examine a plant with the comment, "So this is a fig tree!" or a cream separator to comprehend the principle of its operation. A great deal of our classificatory knowledge comes in this way; topical formations out of materials which are mainly perceptual. But the largest part of our comprehension rests upon, and makes use of, the "topical" or "multiple" association, *i.e.*, a constellation of sensimaginal factors which are held together and given their topical meaning by a single uniting function in the central nervous system. The form of association is represented by the following schemata:



In (1) a topical associative center (T) arouses neural tendencies, leading in many directions, m, n, o, p, q. For example, I hear the word "sunset" which immediately arouses a definite meaning; but as I further consider it the "sunset" topic is presently enriched by such associative completions as "the view last night from the hill" (m), "that picture of Turner's" (n), "those evenings in Naples" (o), "that occurrence at the close of a clear day" (p), "the end of work" (q), and so on. Thus by means of manifold associative connections is "sunset" extended from a presented object to a topic. Never do we realize so keenly the operations of understanding as when acquaintances discuss in our hearing topics (*e.g.*, foreign exchange, the British Cabinet, the composition of brass) for which we possess meager associative resources. Experi-

ments have shown in a striking way the actuality of these multiple associations by reducing them to two of equal strength. Müller and Pilzecker prepared pairs of nonsense syllables after the pattern



where, in several syllables, *a* was followed as often by *n* as by *m*. Later, when *a* was presented by itself, with the instruction to give a syllable which went with it, the observer's attempt frequently failed because *n* inhibited *m*, and *m n*. Here *a* was a bare nonsense syllable, such as *juk* or *zer*, and it did not lead on to other syllables because there were only two associative leads and these were of equal strength. This blocking is known as "reproductive inhibitions." Ordinarily we do not suffer from it because our topics have many associative outlets of unequal strength and we take them in order, thus gradually extending our knowledge about the subject in hand. We do, however, complain at times that our "heads are empty," and that we cannot comprehend even a simple exposition. And now and then, when we are shown a word and instructed to answer with any other word which comes, we do sit helplessly and gape just because two topical leads are equally strong and equally immediate and so neither proceeds to its goal. Thus, "vinegar" resulted in a blocking for me because "jug" and "acid" checked each other. Interesting topics are those in which the *T* will have one meaning or another according to circumstances. Thus "man" may mean the human species or the male sex, "labor" either work or a party opposed to capitalism, "suit" either clothes or a legal process. Here the *T* leads either to an m_1, n_1, o_1, p_1, or an m_2, n_2, o_2, p_2. According as we start in the first way or the second do we proceed with things relevant to the one topic or the other.

In topical comprehension which falls under schema (2) many associative tendencies and their corresponding bits of knowledge conspire to lead the organism on to a new topic. Upon a tardy entrance to a lecture or a moving picture theater, one listens or looks until the topic suddenly emerges. So also in starting a serious book, whole chapters may be read in a haze until, at a given page, the meaning of the whole flashes out. Here we profit by the accumulation of associative material which suddenly takes form and meaning. The method of scientific discovery sometimes takes the same course.

The Place of Abstraction in Understanding

In perception we found the tendency to abstract parts and aspects of an entire object. Although we speak of perceiving an object or event as present, what we actually apprehend, in most cases, is that a present object is long or large or farther away than another or that it has changed; that an event is progressing rapidly or slowly; that one horse is passing another in the race; or that the water is falling with a roar. No object is ever exhausted by a single apprehension. On the contrary, one aspect or relation is noted and then another. So we must speak of a selectiveness of apprehension; a selectiveness which rests in part upon the limits of the organism (sometimes called the "range of attention") and in part upon the predisposition or *Einstellung* of the moment.[3] This partiality or ab-

[3] What is of first importance in that form of partial knowledge which is commonly called "abstraction" is the fact that *certain* of the mental factors present and *certain* of the bodily arrangements are brought into requisition for the appropriate functions; while the rest of experience and the rest of the body either remain neutral and non-productive or merely accessory, so far as the given apprehension or understanding is concerned. Suppose that you sweep your eye along a horizontal chalk-line drawn across the board. Your apprehension of its length primarily depends upon somæsthetic processes from the pull of the eyes and the turn of the neck. The visual

stractiveness of function is also important in comprehension. It contributes to the topic in two ways. (1) The object or event apprehended in diverse ways may itself, when these partial views are brought together, supply a topic.[4] This we may call an "aspect" topic. We say in such cases that we "know all about" the object. So "corn" or "iron castings" may be topical, derived from a multitude of partial or abstractive perceptions which have been acquired in the field or at the foundry. We "know all about" corn or iron castings. At no given time is all of this knowledge actualized, item by item; neverthless the "corn" meaning or the "castings" meaning is of the topical kind which carries in a potential way our acquaintance with a definite kind of object. (2) Where the perceptual meaning is centered in the general nature of the object, instead of in particular qualifications, the object comes to typify a class or kind: "This is a table," "There goes a wild duck," "What a collection of books!" Here comprehension gives us something very much like the image of general reference. It is not quite so general as that because it has a spatial and temporal locale; but at least it is the typical example of a whole group. Since the topic is not specifying and cumulative—as in the case of the corn and the castings—we may speak of it as the "generalizing" topic.

It appears from the experimental studies of abstraction that the organization of the "selected" qualities at high degrees of clearness automatically throws out of function the adjacent and

---

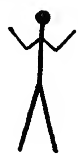
qualities are necessary (of course you must see the line); but so far as the length-apprehension is concerned they are accessory. In addition there are many other qualities present at low degrees of clearness which simply do not enter into the perceptual function. This is the secret of the organism's ability to cope with one thing or one aspect at a time; namely the selection of certain appropriate resources out of the total number of present processes and devices.

[4] This inclusive knowledge of an object Dürr calls "conceptual apprehension." (*See* H. Ebbinghaus, *Grundzüge der Psychologie* (1913), Vol. II, p. 274.)

"outside" factors. Thus Grünbaum and Moore found that when a repeated geometrical object came to be "accentuated" in attention, the remaining objects were seldom perceived. (A. A. Grünbaum, "Ueber die Abstraktion der Gleichheit," *Archiv für die gesamte Psychologie* (1908), Vol. XII, pp. 340-478; T. V. Moore, "The Process of Abstraction," *University of California Publications in Psychology* (1910), Vol. I, pp. 76*ff.*). One observer could draw 21 objects where he had failed to notice by "abstraction" a repeated object, but only 3 objects where he had noticed the repeated object and so "abstracted" it from the others (Moore, 124). This fact probably falls under the law of limitation of function. Thus the alleged "abstraction" of a single aspect or feature would be a kind of functional concentration of the organism upon a specific moment. What the direction of concentration shall be depends (1) upon some formulated task or *Aufgabe* (*e.g.*, "note the color of the rose," "select the largest apple," "look for a repeated figure"), (2) upon a fixed trend of reproductive tendencies, or (3) upon the effectiveness of some such stimulating agent as a compelling odor or an intensely bright light.

Do not think of the abstraction as a functional performance broken into parts or bits. It gives partial *knowledge;* but no *function* is of itself partial. The apprehension of any single aspect or relation is just as complete as a more general and exhaustive survey would be. A confusion of psychology with logic too often leads to the false assumption that the total object is first given and then analyzed by an abstractive process into color, size, movement, and other properties. The real abstraction occurs when we regard the object totally, as "that thing," without associative supplements which would qualify it with details and aspects. In the second place, an aspect may itself become a topic, such as the height of objects or the rate of movement. Again, by the collection of partial aspects we either note the likeness or the difference of things with respect to their apparent height, rate, and the like, or compare various aspects with each other and proceed to acquire knowledge about their relations and dependencies, as if they had an independent existence. Thus we observe that the height of children generally increases with age or that the rate of movement in the clouds depends upon the velocity of the wind. When the aspects or qualities form independent topics we increase our facility with them by ascribing separate names or by the use of some total image of general

reference in which the aspect in question is emphasized. Thus, "height," "pitch," "heaviness," "color," and hundreds of like words symbolically represent independent qualities which have become topics; or visual images whose signification is equally abstract may perform for the organism the same service. A further stage of abstraction is attained when this rounded-out object is used symbolically to represent, not an individual, but an entire class. "This," we say, pointing to the object, "is a tree"; or we entertain a total-image, an *exemplifying* image, which means that "here is a representative of a class." And the final term of abstraction is reached when the object loses all individuality and *is* the class. Then we have the concept. So frequently do we fixate and express the class by a word ("animal," "living being," "justice") that we fall into the mistake of thinking that the concept *must* be indicated by a verbal symbol. The word is, to be sure, the most convenient; but the organism will make use of any suitable material at hand to carry the conceptual meaning. Thus a schematic visual outline such as



may mean "human being," the raising of the upper lip and an imaged growl may mean "predacious beast," and a general kinæsthetic stiffening may be "courage." In these cases the meager mental qualities and their bodily accompaniments do not mean that this is a particular human being, some certain predacious animal, etc., but the class-at-large.

This entire process of "abstraction," which gives us both our "aspect" topics and our "generalizing" topics, is of the greatest importance for the thinking functions, as we shall presently see.

The Question of an Acquisitive Function

The study of comprehension brings us to the query whether our conquest of the world of knowledge involves a new and unique function which can be called "learning" or "acquisition." Many psychologists take "learning" for

granted. Some of them write entire psychologies with "learning" as the central theme. Since these psychologists, however, either disagree upon the meaning of learning or else give it an extra-psychological interpretation, we shall have to decide for ourselves whether the word really expresses a specific and typical mode of operation. One "learns," as we loosely say, one's history and economics; one "learns" to skate, sew, walk, and play tennis, to add and subtract; "learns" to study, to avoid danger, to do things the easiest way, to keep silent in sudden anger, to eat proper food, to tell the truth.[5] Do all these "learnings" spring from a common way of doing, from a common "learning process," as the educationists say? To mean so much, the word "learning" has evidently been used in various senses. Let us examine some of the commonest employments of it.

First, "learning" has been used to describe or to explain any abrupt modification in behavior. If an organism can now do something which a little time before it could not do (escape from a maze, turn in a narrow space, defend itself from attack, distinguish meat-juice from paper pellets) it has, in the meantime, according to this criterion, learned; and therefore—so the champions of this kind of "learning" usually add—it must be "conscious." Besides being a doubtful criterion of anything, "learning," so taken, tells us nothing about means or operation or function; it only remarks a modification of accomplishment and infers that the modification implies some unknown "conscious" power or operation which it calls "learning." Another common meaning of

[5] If we were to forsake the mode of acquisition for the thing acquired, we should have an indefinite number of "forms" of learning; but these varieties would have no more psychological significance than a list of the morning and evening papers would have for the process of printing; and in addition we should have confused in the products of "learning" the combined issues of perception, memory, action, and all the other psychosomatic functions which we have been at pains to distinguish.

the word is the educational meaning, wherein the pupil is said to "learn" when he has acquired the contents of the curriculum, without regard to means or procedure. Thus he "learns" his lesson in arithmetic, spelling, grammar and reading, he "learns" to draw, write, and swing Indian clubs, he "learns" to attend and to be prompt, and he "learns" to study. All desirable ends from the standpoint of pedagogy; but scarcely a psychological use of the term!

A third exceedingly broad definition of learning extends it to all abilities and skills acquired by the individual on the basis of its native or instinctive endowment. This is the historical interpretation of learning, an interpretation which is at present popular in that branch of behaviorism which is inclined toward a genetic account of education.[6] Under this definition learning tends to take the form of "improvement" and of an advance toward "efficiency," and so to be estimated in terms of value rather than described in terms of the natural sciences.[7]

A fourth employment of the word restricts it to the establishment of associations.[8] Thus we say that we "learn

[6] *E.g.*, E. L. Thorndike, "The Psychology of Learning," *Educational Psychology* (1913), Vol. II, p. 1. "Human nature, in general, is the result of the original nature of man, the laws of learning, and the forces of nature amongst which man lives and learns. . . . The original human tendencies include also certain ones whereby modifiability or learning itself is possible." For Thorndike, learning involves "mental functions" which are "any segment or feature of behavior" or "any learnable thing." They include "abilities," "skills," "interests," "desire," "fear," "rate of reading," etc.,—a list as comprehensive as that of the Walrus, when that amphibious polymath undertook to "talk of many things." The mental function is studied "by means of its results upon . . . behavior" (*ibid.*, pp. 59-60). Function in these senses will not be confused with our psychosomatic modes of operation in the text.

[7] Education is specially interested in changes of the "condition of a mental function" which "is very often described in terms of so much 'gain' or 'improvement' as an 'increase in efficiency'" (*ibid.*, p. 67).

[8] "Learning is no more than the formation of association," W. B. Pillsbury, *The Fundamentals of Psychology* (1922), p. 365. This use

a poem" when we establish associative connections between the words and the stanzas and are prepared to repeat it. Complete learning is called "learning by heart" or "committing to memory." The term has been so used by those students of association who have laid emphasis upon the conditions of memorizing, *i.e.*, repetition, the amount of associated material, character of the material, rhythm, part-learning, interval between the repetitions, etc. All of these conditions are important for the organization of experience (*Cf.* Pt. II), and they also show us how the mind-body comes to be equipped for its various functions; but they do not imply any unique way of operating which is peculiar to "learning." We "learn" (in this sense) by perceiving objects or nonsense syllables over-and-over, or by running through them as memories, or by repeating topics as we read, or by thinking out and forming logical connections. Retention and subsequent recall are really distant results of any one of the main types of function.

If there is, then, a genuine "learning function," which is distinct from apprehending, acting and understanding, it will be something much more specific than anything so far proposed under this term. We might depict in comprehension an approach to the essential factors of real learning, for this operation includes, as we have seen, not only old knowledge but also the extension and modification of topics. Do we not add a new resource of the organism, over and above comprehension, when we acquire?

In riding up the thoroughfare on the car to-day, I was entertained by reading the signs along the street: "Western Union," "American National Bank," "Stoddard and Grimstone." Presently I saw "Toyo Kisen Kaisha." That sign

---

of learning (*Lernen*) is common in the German literature of association. *See* H. Ebbinghaus, *Grundzüge der Psychologie* (1911), 3rd ed., Vol. I, pp. 649*ff.*; E. Meumann, *The Psychology of Learning* (J. W. Baird, trans.), 1913, pp. 34*ff.*

I had seen before. It is the name of a great steamship line. Can I say it? Can I write it? I must "learn" it. Yes; it begins T-o-y-o (or *a*?). I will run it over, noting each letter until I have it. Is there not something here which is not mere understanding? I do not translate, for at the moment I do not know what the words individually mean. It is not mere apprehension. I apprehend the other signs; but here I have thrown into commission what appears to be a new resource. Once more! Suppose I know Ach's two books on voluntary action; but not the exact titles. Is "Willensakt" in the second or in the first? Is it "*den* Willensakt" and "*die* Willensthätigkeit;" "*das* Temperament" as well as "*das* Denken?" Was the first published in 1905 or 1906? I must clear up once and for all the whole matter of the titles. I "learn" them with care, and now they will be permanent "possessions." And again. My car when cold has an annoying way of gasping after the first revolution of the engine. I must "learn," by the use of choke and gas-pedal, to keep it going for the first critical thirty seconds. I set myself the task, and presently master the difficulty. Finally, the technique of the nonsense syllables well exemplifies the difference between ordinary comprehension and these forms of "acquisition." I can, to be sure, put fictitious meanings into the several "senseless" syllables, thus stringing them together into a "topic"; but then they are no longer "senseless" and the real aim of the method is defeated.[9]

[9] This is precisely the aim of the untrained observer. Experimenters who have encouraged their subjects to "retain the series" as rapidly as possible by any device which they can contrive may well refer to Ebbinghaus's first careful use (p. 35) of the method. The result may "test" the subject's cleverness in devising topical expedients much more than his "memory." This ambiguity of procedure is a common defect of the uncontrolled "test." Ebbinghaus himself recalls Kant's distinction between the *mechanish* and the *ingeniös* learner. For a description of the aids and devices of learning, *see* G. E. Müller, *Zur Analyse der Gedächtnistätigkeit und des Vorstellungsverlaufs* (1913), Vol. III, pp. 1*f*.

Now what is the common factor in all these cases where something is "acquired"? Precisely what we found in the *instructed* forms of action; the setting of a specific task or *Aufgabe*. When we take away the practical benefits to the organism in getting and in holding new knowledge or new skill, what is left is the exercise of one or more of the functional modes which we already know (apprehension, action, and understanding), *plus* a self-instruction to acquire. When we say that "we are going to try to remember" or "to learn," we simply mean that we are going to exercise these functions under conditions which will be favorable to our future experiences.[10] There is no special function of "fixation," and there is no special function of "retention."—When we have finished our account of the various functions, we shall consider altogether the tasks and the various other means of initiating and preparing the organism for its functional operations.

---

[10] In our common phrase, we "intend to remember." This does not imply, however, the formation of real memories, *i.e.*, of imaginal complexes which shall carry a memorial meaning. To speak strictly, the series of nonsense syllables is not, as a rule, "remembered" after the 4th or 8th or 15th repetition. It may be "learned by heart," in the sense that it can be repeated without reference to the written or spoken list, but not in the sense that the syllables now appear as objects set in a past context. They are simply "present." To be sure, there may appear also the knowledge that these identical series were presented; but that is only external and incidental. The real accomplishment is to write or to recite without extra-organic aid a certain list of syllables. The remembrance is logical, not psychological. The accomplishment is quite different from the apprehension of a series of objects or events whose existence now specifically refers (as the recall of my progress toward this building when I walked an hour ago) to a past experience.

CHAPTER XV

THE ELABORATIVE FUNCTIONS: THINKIN

The Nature of Thinking

The ancient belief that thinking or "reasoning" is a universal mark of human beings is not easily supported by fact; but it does suggest to psychology a problem of great importance and interest. What is this thinking which has long impressed man as a peculiar and notable possession; which has both revolutionized the conditions of his life and served his purposes in the control of nature? Is it a mental process, a special form of psychical force, or some inscrutable faculty baffling his observation? If we are to seek an answer to these questions upon the nature of thinking, we must leave the region of vague speculation and regard the subject as concretely and directly as we can. Then we shall easily assure ourselves that thinking is, as perceiving, remembering, acting, and comprehending are, something which is performed or accomplished by the organism. In thinking we "think out," we solve some problem; we come upon some new bit of knowledge, a convicting belief or opinion, or a new way of regarding nature and knowledge. The members of the budget committee think out a plan of equable distribution of the city's income; the housewife thinks out a way of reducing her kitchen fuel as the cost of coal advances; the pursued bank robber casts about to devise by thinking a means of escape; the scrupulous voter seeks by thought to "make up his mind" upon the merits of a political issue, and the scholar determines by thought a new plan for attacking his problem.

The psychology of thinking is difficult, difficult of approach by scientific methods of study and difficult also of exposition. Although it long ago attracted the attention of the philosopher and the logician, no means for the empirical study of it were for a long time discovered. The approach in the laboratory was made only when experiment had been successfully applied to the problems of perception, memory, and action. Then little and simple instances of thinking were taken, given as problems to trained observers, and the outcome noted. Two surprising results were soon obtained. First, the observers confessed that usually they found nothing that could fairly be called "thinking." It was as if a fisherman should cast his line into a well. There was apparently nothing to catch. When asked to judge which of two tones was higher or stronger, which of two lines longer, which of two lights brighter, they either found simply that the decision appeared in the form of a word (as "the second," or "that one") or that they sat in suspense until the designation came. Apart from the qualities of sensation and image, nothing appeared; nothing that could be dignified by the name of thought. Secondly, certain observers who took more complicated tasks—such as the classification of a given object—found materials which they could neither classify nor describe. There were sudden flashes of something which seemed to mean "now I have it," "this is working out well," "how shall I proceed?" "how difficult this is!" and other such internal comments or exclamations. These sudden turns and tricks of thought, which resisted analysis, were called *postures*[1] (Bewusstseinslagen), *awareness* (Bewusstheiten), *knowings* (Wissen), and *concepts*

[1] The curious German word *Bewusstseinslage* has usually been translated *attitude*; though the original word is frequently retained in English contexts. "Attitude" is unfortunate because it is also employed in quite another sense; namely, the way in which objects and situations are "taken" by the individual. Thus one takes an interested, observ-

(Begriffe); and psychologists began to say that these were, as they believed, the true "thought processes" or "thought elements."

Before we can place an estimate upon these alleged elements of thinking we must revert to certain distinctions which we have already had occasion to make. First of all the distinction between "mind" and "meaning."

Mind and Meaning

With "meaning" the student of external nature has little to do. In the physical sciences men make sure that the observer is trained and reliable; then he is taken for granted. The observer is as necessary as the apparatus; but he is only one of the conditions of the experiment. He is not himself the object of study. How his mind works—so long as it works accurately and effectively—is not considered. How his knowledge can correspond to some fact in nature does not concern the physicist, whose whole interest lies in objects, changes, transformations, forces, and the like. This neglect of the observer is common to physics, chemistry, zoölogy, geology, and all of the other physical sciences. It is only when we consider our observations, discoveries, and theories in their dependence upon the experiencing organism that facts of a different kind appear. Then we find blue, red, green and purple lights, high and low tones, harsh and deep noises, suffocating and fragrant smells, and many other things of the same order which are obviously not wave length or air compression or chemical diffusions; but which are immediately necessary to our first-hand knowledge of these physical facts. A relation does clearly exist between the two orders; and this relation we acknowledge when we

ing, or aggressive attitude toward something or somebody. The word "posture" has a strange sound; but it is free from confusing psychological implications, and it seems, moreover, to express fairly well the meaning originally conveyed by "Bewusstseinslage."

say that the processes set going "within the senses" mean, indicate, point to the lighted object, the musical or raucous sound, the chemical transformation, etc. Viewed from the other end, we may say that the outside objects regarded as thus dependent upon experiences connected with the living organism are what the experiences mean or signify. So "meaning" is not any new kind of separate existence; but only objects regarded in this factual way with respect to the organism. It appears only when we have discovered that without our mental qualities and integrations the objects would not—at least not for us—exist or be known.[2]

To this functional relationship which exists between mind and objects, we must add one more relevant fact, a fact which we have set at the very basis of our exposition. It is the observation that this functional relation never exists, so far as we know, save in coöperation with the physical body. It is the mind-body which perceives, remembers, acts, and thinks. We obtain, then, a functional relation which takes us beyond the abstraction of the physical object, on the one hand, and the mental existence, on the other. The resources in thinking—as in the other functions—are always of the psychosome; and the things wrought out are never mental or bodily but thought-products. The resources taken separately or the products taken separately leave out meaning, which is their imminent relation.

Now we return to our subject of thinking to discover what it is (the nature of elaboration), what resources of the organism it commands (the psychosomatic factors), what initiates it (the thought-incentives), and finally how it is carried out (the thought-operations).

---

[2] Sometimes students of epistemology take "meaning" in another way. Any object is regarded as having meaning when it stands as a symbol of something more abstract. For us, as we shall see, this is only one special case of meaning.

The Intimate Relation of Thinking to the Other Functions

Let us make sure, first of all, that the thinking or elaborative functions are not disjoined from perception, action, comprehension, and the others which we have already studied. As we have already discovered, the functions are hierarchical; some of them basal and others of them incorporating the simpler in their more inclusive scope. The common opinion—possibly derived from the tendency to close the eyes and ears and to sit passive when we reflect—that thinking is divorced from other operations is wholly erroneous. On the contrary, it uses the others, but in a new and characteristic way. Let us see how.

We begin with some simple tasks, tasks which do not require symbols and which are carried out in apprehension and action, and then proceed from them to thinking.

Suppose that I have been marketing. I consider whether the bill just now handed to me in making change is genuine or counterfeit; whether I can carry all my parcels; whether I can recall the order of my errands in the stores and so recover my lost umbrella. Here are three tasks awaiting solution. The bill I scrutinize as regards coloring and engraving, comparing it with another in my pocket. The parcels I run over with my eye, consolidate, fit into my arm and cram into my pockets. The path to the various stores I retrace in visual imagery, verifying my purchases in hand. The tasks once formulated are, as we shall conceive them, carried through by perception, action, and memory. What is added when I think? When, for example, I am asked whether financial embarrassments or domestic cares are the more frequent causes of legal divorcements. The problem itself calls for symbols, and so does its solution. It may be verbal symbols; or it may be—as at the present moment it is—presented in a vague, visual total-image whose symboli-

cal meaning is a "court room," together with another thin visual image which stands for a "worried man of business," and a mixed somæsthetic and auditory "cackling" which signifies "domestic infelicity." "Business trouble" and "infelicity" are somehow set against each other by a right-left balance of strain qualities. So far understanding, the first prerequisite to the problem. Now I know, in this symbolized meaning, what I want to discover and to decide upon. As for the search, I wait at first, as for a foreordained conviction. It is at this point that thinking often breaks down. We tend to avoid real elaboration, hard thinking, by an opinion ready-formed or by a prejudice or prejudgment. The symbolized cachophanous jangle seems somehow more compelling; so I am tempted to say, "Oh, domestic cares lead naturally to friction, of course!" But this is not to think, so I begin again. Immediately appears visual imagery, which symbolizes "myself reading from the daily papers," and then the words "usually outside persons are involved," with the conviction "but this is not in the problem" . . . "domestic cares *versus* business embarrassment." Once more I begin with a restatement. The newspaper symbol reappears and now it means in addition "these cases often tell of stress, hardship, and resulting friction." Then a flash of something which signifies "I incline toward that side." Thus I proceed, shifting and developing my symbolic materials, falling into attitudes of doubt, inclination and uncertainty, with, finally, the words "no decent method: I do not know" and an accompanying conviction which reënforces the hopelessness of the quest with the limited knowledge at hand. Not an important conclusion, you will say, so far as the burning domestic question is concerned. True; but we have at hand all of the materials and procedures of thinking. Now let us try to reduce them to their lowest terms.

The Main Aspects of Thinking

Within the last twenty years a great number of inspections and commentaries have been collected from researches upon thinking. Although many of them run into the phraseology of logic, inventing all manner of new terms and alleging a wide variety of doubtful operations, we may sift out of them all the following essential ingredients of the elaborative functions: (1) the comprehension of a problem or "task," (2) mental and bodily ingredients which create secondary or symbolic meanings, and (3) the modification of the "task" by means of the symbolic meanings. Putting these requirements together we may provisionally define the elaborative function as *a search initiated by a problem or task and carried on by the aid of symbolic meanings.* The natural completion of the function appears in the *solution*; just as the action is completed by an appropriate organic movement and the mental qualities which attend it; but in either case the function may be in process in spite of the absence of a final resolution. It is the problem, its character and its origin, and the search for its solution which will primarily concern us. For the *thought* itself, *i.e.*, for that bit of truth or falsehood, of knowledge or fiction, which emerges from the operations of thinking, we care not at all. That is to be left to the logician and the philosopher.

Since elaboration is to involve for us a real search, we must exclude at the outset all those substitutes for thinking, those formulas, opinions, prejudices and traditions, which are current in human society and which bear superficially the marks of real solutions. So highly socialized is the organism that it is constantly adopting customary beliefs and expressing them as its own. "What do you think," we ask our neighbor, "of oriental rugs?" "of cut glass?" "of this or that political principle?" As a rule, the answer comes, not from thinking at all, but from a fixed concurrence in, or a

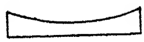
remonstrance against, a prevailing opinion. Even the dissenter, who often appears to think because he dissents, may simply voice a determination to disagree with the group.

The Determination of Thinking

The term "task" suggests that thinking is carried through by a determination, as action and comprehension are. That is true; and this common fact of being determined should help us to relate all of these functions. In action, as we saw, the determination is set for organic movement. The way to move, the time to move, and the coördination of movement with apprehended objects, make up the action-problem. In comprehension the end is understanding. We gaze upon the new radio equipment, we revive the recent words and facial expression of our neighbor, we listen to the lecture, and we read recipes in order that we may understand. When the task involves acquisition, the end is possession. We repeat the lines, we run over our scales and exercises, we follow instructions from the tutor in golf, in order that we may learn, use, and control. In a similar way, the determination of thinking is set toward the goal of discovery. Thinking is a search for knowledge and for conviction, and for knowledge and conviction which are not yet at hand. It leads on to an end which the logicians call a "judgment," an "inference," or a "conclusion," according to the *logical* steps involved.

Symbols Employed in Thinking

But if thinking is distinguished from the other determined functions by the direction in which the determination works itself out, it is also distinguished by the use which it makes of symbolic meanings. Now a symbol is, as we already know, a secondary meaning; something which is to be regarded as the meaning of a meaning. The word, the wooden finger at the cross roads, the red light swinging in the streets,

the scrawled figure of skull and bones, and the "disgusted" shrug of the shoulder are symbols. For the word is not the only symbol. Almost any object meant or intended may upon occasion derive a secondary or symbolic meaning. G. E. Müller has shown that even nonsense syllables may carry this kind of reference, *i.e.*, that the apprehension of a nonsense object "arouses the idea of another object which serves as a symbol of the first." [3] Thus a syllable of three letters whose first and third members were more impressive than the middle carried the geometrical meaning , an impressive middle letter was represented by , and the number series, 1, 2, 3, 4, . . . by . These symbolic meanings, which usually come with emotive states, sometimes serve as aids to learning. Then they fall under the heading of mnemotechnical devices. Colvin [4] found a like symbolic use, which he calls "mimetic," of somæsthetic complexes, a kind of "inner sign-language" which replaced words. Thus a nonsense series was represented by a "sequence of movements" which meant their arrangement and order. Colvin believes that these somæsthetic symbols are remnants of gestures and bodily poses. Both instances are interesting in this connection because they represent typical means of supplying—along with words—highly abstract materials for thinking. They also throw light upon the history of the *posture*, which, as we shall presently see, plays an important part in elaboration. Any observer who is intent upon the symbolized meaning is very likely to overlook

[3] G. E. Müller, *Zur Analyse der Gedächtnistätigkeit und des Vorstellungsverlaufs* (1913), Vol. III, p. 385.

[4] S. S. Colvin, *Psychological Review* (1910), Vol. XVII, pp. 263*f*. K. Koffka, who also remarked the symbolizing visual image, similar to Müller's, thought it attached to the *Bewusstseinslage* or "posture." *Zur Analyse der Vorstellungen und ihrer Gesetze* (1912), p. 265.

both the primary meaning and the mental and bodily conditions behind it. Were verbal meanings not so obviously anchored to sounds and to visual characters, it is likely that the "imageless thinkers" would confuse them, too, with floating "thought elements."

Men sometimes speak of the symbol as if it were a primary object. Thus the picture-image of imagination has been called—even by psychologists—a "mental object" (as if it were a part of mind), and its artistic or religious significance its symbolic "idea." Mind, says one recent writer, is active "by way of images . . . and percepts." The image in itself (as in the verbal image "horse") has "no interest of its own at all, and the meaning is practically everything, so that 'idea' is obviously the right term to use." We cannot, however, arrive at a consistent psychology of thinking, an account which will properly relate thinking to the other psychosomatic functions, until we see that it is of the nature of thinking to operate with meanings which are themselves abstracted from other meanings of another order and therefore symbolic. For the purposes of æsthetics it would be permissible to speak of an object, *e.g.*, the armed and girded figure of justice, as being symbolic; but in psychology we must go a step farther and observe that all meaning, all reference to something else, is ultimately to be traced to mind itself.[5]

In the second place, the symbolic meaning does not necessarily involve thinking. To see the swinging light at the rail-crossing before stopping the car does not require thinking. If it did, accidents would multiply. Perception itself

[5] One might, of course, stop by convention with the primary meaning, *e.g.*, the total image, and call that some kind of an object, say a "memory object." But we must not identify it with the mental qualities to which it stands in a functional relation. A doctrine and classification of objects would be of great aid to the psychologist. (*Cf.* A. Meinong, *Untersuchungen zur Gegenstandstheorie und Psychologie* (1904), pp. 1*ff*.

contains symbolic reference. Especially does one object point to another by way of anticipation, filling out the perceptual field both in time and in space. And as perception passes over into comprehension, one of its main vehicles is the symbol. Then the object is not simply itself and not simply another anticipated object; it represents either its whole class or it stands for a topic. Thus the first cry of wildfowl by night may mean "the ducks have come" or "autumn is approaching"; a shiny place upon the elbow "this suit is wearing out" or "writing is hard on clothes"; the heat of the June sun "summer is here." Thus does understanding itself make first-rate and frequent use of symbols; but we must not for that reason confuse it with real thinking.

Another confusion of thinking identifies it with imagination. Let me illustrate. After my house is built convenience suggests an additional door in a basement partition. I consider putting the door in myself at odd moments. To this end I sit before the plastered wall, deciding where the door should go, how much room it can be allowed, and which way it is to swing. I roughly measure the space with my eye; I bring the square; I allow a margin for casings; I query whether I can build the facings vertical and miter them neatly at the corners. A flash of imagery means "the lumber yard," another flash "the telephone." I see the task as half completed, trying to anticipate difficulties which are new to me. Thus I begin with perception and action, working out my problem by way of imaginative apprehension. I may, of course, really *think*; but the chances are that other functions will suffice. That is to say, I conceive a problem and work it out on the basis of present perceived conditions by concrete alteration and construction, carried through in concrete imaginal terms. The work of the architect, the designer, and the city planner is largely done in perceptual and imaginational terms to which are added rules and conventions under which the ideal construction proceeds. But

if symbols or secondary meanings are created in perception, comprehension, and imagination, then what is the differentia of real thinking? It is the novel use which is made of the symbol. The signboard symbol is incorporated into the perception or the action; the Niobe symbol into my understanding and my emotion of pity; but thinking uses the symbol for the production of new knowledge, or to bring a conviction or assent. "Why," I ask myself, "do these catalpa trees grow brown at the same time that the autumnal rains are refreshing the shrubs and turning the somber fields to green?" My botanical information is not sufficient for a good answer; but I can note what does come when I thus raise the problem. A total image, whose primary meaning is "rusty and half naked trees" and whose symbolic meaning is "decay in autumn," is accompanied by the verbal signs "deciduous . . . annual changes . . . independent of rain," and by the visual apprehension of two vague lines running in opposite directions whose symbolic references are "toward spring" and "toward autumn." Presently I come out with the general conclusion that there is no real contradiction in nature but that different conditions of life produce unlike effects under the same conditions of climate and weather. Take another instance. There is proposed the problem: "Will it rain tomorrow?" I *may* answer the question without thinking; for I may say, "Yes, it feels like rain," or "Yes, it always rains when I plan to be out of doors," or "No, the morning paper says *clear*." But suppose that I do think; that I get the weather map and examine the sweeping concentric lines; that I pass to their symbolic significance, "a low pressure area," "a steep barometric gradient," "high winds to the south." These symbolic meanings are put together under the problem, organized, and then new knowledge and the conviction "Yes, probable rain ahead" emerge.

We have spoken of the "creation" of new knowledge; but of course thought is not made from nothing. Were it

not for the past, we could not so much as propose a thought-problem. The young child, the cub and the chick have literally nothing to think out. They may be startled, or inquisitive, or curious; but they do not propound to themselves questions which demand thinking for an answer. So to propound implies that the organism already has knowledge which it seeks to extend. The thought-determination always derives from the individual's past experience. There are no inherited thought-problems; though the innate equipment of one individual organism may be vastly better than that of another.

The Materials of Thinking

1. *The Mental Qualities and Structures*

We have seen that the psychologist's first search for "processes" of thinking was disappointing; that the materials used were disproportionately meager when compared with the importance of the end-product, the thought. I ask myself, "Can space have an end?" Immediately a hazy bit of visual imagery of some one going on and on across a pathless expanse (primary meaning) appears. This represents an effort to come to the last station in space (symbolic meaning). Whenever the vague "some one" stops, space spreads on and on. Always a new march. With a change in the direction, the result is the same. "No," I exclaim, "space cannot have an end!" Whereupon verbal symbols "but space may be just certain properties, and these properties may fail?" Then the flash (*posture*), "Why not?" Not an ultimate solution, by any means; but I have thought; I have proposed; I have searched, and I have used symbols to advance the problem. The *value* of the solution does not concern me. A large problem to manipulate by a flash of imaginal gray and a tendinous pull in the shoulders. The reason why the mental qualities seem so inadequate is twofold; we wrongly leave out of account the physical or-

ganism, and we forget that all thinking is a *prepared* function, that the train for it has always been laid in the past. Thus we must always include the body and we must always take the individual history into account. In our small example the notions of a homogeneous space, of going on and on, of existence beyond the dome of the heavens, and the like, are prepared in such a way that they now touch off with meaning the threadlike items which appear; and the body, on its side, is so prepared that it is able to sustain the determination-to-solve while the relevant materials are brought to hand. An earthquake, as Madame Defarge observed, comes and goes very suddenly, but it is a long time in the making.

We say of those actions of the newborn animal which are performed straightway and without tuition that they are racially prepared, innate, "instinctive." Just as much are the elaborative functions made possible by the past—not the racial past, in this case, but the individual past. To search, to propound, to gather material, to deal abstractly by way of symbolic meanings presuppose antecedent knowledge and antecedent search. So we shall not be disappointed when our quest for mental materials (following the pioneers in the descriptive analysis of thinking) yields insignificant items which, taken one by one, bear no resemblance to the significance of the elaborated meaning.

In our instance of the unending space, imaginal structures of a visual sort were the chief mental vehicles. And tens of thousands of inspective analyses have convinced psychologists that imaginal materials of this kind (not always visual) play an important part. They are, on two counts, more useful than sensational patterns. First, the image comes with less of the specifying and particularizing reference of the primary incorporation. Primary structures are very likely to mean "that object yonder," "the thing which is pressing upon my skin," "the savory food," or "the rum-

bling traffic of the streets." To be sure, the memorial functions tie us, by way of imagery, to the concrete past; but the interference and decay of associative tendencies insure us a supply of these sensimaginal materials which stand free of concrete objects and dated events. In the second place, these groups are useful for thinking because they readily carry aspect-meaning. They are in this sense "abstract." We have found these aspect meanings even in perception. As I write a strange bird flutters in the pepper tree outside. I perceive a flash of red as the bird spreads to maintain its balance. That is the main perceptual meaning; "a flash of red." To say simply that I have a visual perception of a bird in a tree misses the point. And with the detached and reassorted scraps of sensimaginal stuff appearing in thought, the abstraction goes still farther. The meanings conveyed are not attached to a hard unyielding "present" which they are bound to support and to amplify.

So we begin with these materials whose primary meaning is highly abstract and whose symbolic reference is still further removed from the concrete and the particular. On this side, the thinker is limited only by his resources from vision, audition, strain, and the other senses. Although the range of endowment is fairly wide—certain individuals wanting visual, others auditory, and still others tactual qualities—most persons are provided with these simple materials far in excess of the usual demands of thinking. Of interest is the kinæsthetic or "motor" type, wherein tendinous strains, either immediate or imaged, take the place of visual and auditory vehicles for abstract meanings.

A special resource of thinking is the verbal image. Although this image is reducible, of course, to the visual, auditory, or auditory-kinæsthetic elements which we have considered, or to somæsthetic qualities from the vocal apparatus, its peculiar mode of reference suggests a separate treatment. To call it "verbal" is to admit that it is not

a mental affair at all. It is a meaning at the second remove, *i.e.*, a symbol. These symbolic images we employ so deftly, as mere counters, that we are likely to forget that always mental conditions underlie them. Certain "unthinking" behaviorists maintain that they are mere "subvocal talking," thus losing sight of the fact that the verbal materials gain their adaptability to the elaborative solutions only by their ability to carry meaning.[6] The primary meaning is "a collection of characters upon the page" or "the complex sound as uttered by the voice." This meaning we may drag into view by monotonously chanting a word over and over or by separating the characters upon the page (*e.g.*, *s t o r m*) and regarding them one by one. Failing thus to banish the derived meaning, we may invert (*ɯ ɹ o ʇ s*), or rearrange (*m t s r o*), until we arrive at a bare collection of unsymbolic or "nonsense" characters. This primary perceived meaning we must not confuse with the mental qualities themselves, which are either the tone-noise complexes or the grays and colors of the double pyramid. The sound-strain object carrying the meaning is just as much a primary meaning-object; although the fact that it has no spatial locality and no single bodily reference has made it still more inconspicuous and still more easily overlooked.

In the psychology of thought itself the precise indentification of the mental constituents involved, teased out one by one, is not of very great significance because it appears that the attachment of the symbolic meaning is either fortuitous (as in imitative or onomatopœic words) or conventional

[6] There survives in some quarters the confused notion that language involves thinking. For example, L. M. Terman defines "intelligence" as "abstract" or "conceptual" thinking, and the "language factor" as the "ability to think in terms of symbols," *Journal of Educational Psychology* (1921), Vol. XII, p. 129. A half hour well spent upon the street corner, in the barber shop, or at a social "reception," should convince any one that no inevitable connection exists between mere "tonguiness" and real thinking.

(as in the vocabularies of the languages). Virtually any imagery or any pliable bit of somæsthesis which is available to the individual in sufficiently varied and reproducible form seems to serve as the ultimate vehicle for verbal meanings. After language is acquired by the individual, the primary meanings are not often separately realized, save by such an exercise as we have suggested. But as experience grows the secondary meaning shifts and expands; and it is realized in thinking, in understanding, and in the verbal communication of meaning by speech and writing. It is only when we see or listen to, or attempt to pronounce, an unknown language that large masses of the primary meanings become conspicuous.

The case is a little different in music, where the significance may reside in the primary meanings of the tonal complex or the tonal "object." When this is destroyed, as in psychological inspection of the several tones, we come back to the qualities of the tonal series. Of course, a further symbolic reference may be added in music as the basis for æsthetic valuation.

Finally, on the mental side, we have to consider those "imageless" things which are alleged to form an important class by themselves and to be responsible, along with words and images, for the operations of thinking. We shall first discuss the *posture* ("conscious attitude," *Bewusstseinslage*), so named by Mayer and Orth.[7] These investigators, when working by the method of paired associates, discovered that something which they called "conscious processes" frequently appeared neither as ideas (*Vorstellungen*) nor as

---

[7] A. Mayer and J. Orth, "Zur qualitativen Untersuchungen der Association," *Zeitschrift für Psychologie* (1901), Vol. XXVI, p. 6. *Cf.* K. Marbe, *Experimentell-psychologische Untersuchungen über die Urteil: eine Einleitung in die Logik* (Leipzig, 1901); J. Orth, *Gëfühl und Bewusstseinslage,* etc. (Berlin, 1903). As early as the 90's, the English psychologist, G. F. Stout, had contended for "imageless" components of thought, *Analytic Psychology* (1896), Vol. I, pp. 85*f.*

volitions (*Willensakten*); factors which their observers failed further to describe and to analyze. Since the "introspection" of these observers was obviously gross, scarcely going beyond imaginal and verbal meanings, the designation itself has little significance. It suggested, however, the existence of a new kind of ingredient, and the suggestion led to further experiments and finally to a fairly widespread belief in new "elements" of thought. The extensive literature on thinking, which has recently sprung up, has supplied hundreds of instances of these alleged "postures," which have also come to be known—at least some of them—as "awarenesses" or *Bewusstheiten*.[8] That they are, at least for the greater part, *meanings* and not raw experience will be suggested by the terms in which the observers have described them. Here are typical instances: "the realization that something is coming," "that one cannot remember," "that one does not exactly know," "that a name is on the tip of the tongue," "doubt," "uncertainty," "assurance," "hesitation," "difficulty," "assent," and "apprehensive fear."[9] Any one who has innocently opened the platform door of a lecture hall and found himself, to his dismay, suddenly confronted by hundreds of disturbed listeners will understand what the writers mean by at least one form of the *posture*. In that case it will be the flash of consternation and embarrassment which, translated into words, would run: "Here I am; what a fool; they all glare; why did I; how can I escape?" The flash itself comes without words. It is a kind of shock of

[8] N. Ach, *Ueber die Willenstätigkeit und das Denken* (1905), p. 210.

[9] For brief accounts of the literature *see* E. B. Titchener, *Lectures on the Experimental Psychology of the Thought Processes* (1909), Lect. III; T. V. Moore, "The Process of Abstraction," *University of California Publications in Psychology* (1910), Vol. I, pp. 76*f*. The methods chiefly used were the "test" (Binet and Woodworth), various forms of the "reaction" experiment, modified in the direction of association and recall (Mayer and Orth, Watt, Ach and Messer), and the simple propounding of questions designed to arouse thinking (Messer, Bühler, Störring).

knowledge, conviction or emotion. It is, as one of Ach's observers said, as if an entire experience had been "given in a nutshell." Under ordinary conditions, at least, analysis is impossible. An enormous significance suddenly appears without imaginal picture and without words. The incidents and turns of a heated argument also offer a fertile field in which to search for postures. When translated into words they run: "I have made my point," "that was an unfortunate admission," "he is not convinced," "I am sure of my ground," etc. There can be no doubt that understanding, as well as real thinking, is filled with this kind of sudden flash. All psychologists admit the fact. Their debate has turned upon the question whether the flash indicates a new constituent, coördinate with the "sensation," or is a meaning which rests upon mental and bodily resources of the organism already known and described.[10]

It is difficult at present to resolve the debated question. The extensive new literature seems at first sight to have complicated our problem of thinking. It is full of new terms and new principles of explanation. But it has really performed a very great service in rejecting the old "intellectualistic" and logical conceptions of thinking and in insisting upon empirical and experimental methods of approach and of interpretation. In particular it has called attention to the vague, fleeting, and obscurely defined moments of thinking, and it has divorced thought from the fixed and stereotyped forms of language and of logical construction. The formal sentence and the "abstract" concept can no longer be taken to represent the operations in these far-reaching accomplishments of the human organism. Now we know that the operations of thinking, the shreds of experience involved, and the bodily trends and tendencies are brief, transitory, and fluid; and

[10] The old antithesis between "sensationalism" and "intellectualism" in the study of thinking may be represented by a single pair of modern references. "Sensations clustered together cannot build up our more intellectual states of mind." William James, *Principles of Psychology* (1890), Vol. II, p. 9. "The psychology of thought, so far as we have it, may be interpreted from the sensationalistic standpoint." E. B. Titchener, *op. cit.,* (1909), p. 194.

that *any* available resource of the psychosomatic organism may be brought into requisition.

Two observations will help to an understanding of the posture.

1. The most obvious aspect of it is the meaning. To set it down straightway as "mental" is therefore to confuse existence with function. The flash of it is a flash of knowledge, interrogation or conviction. The postures might, without changing their significance, be prefixed by such phrases as "I know that. . . ," "I suspect that. . . ," "I am aware that. . . ," "I feel that. . . ," "I am conscious that. . . ," "I am persuaded that. . . ." Like the apprehended object, the topic, the thing learned, and the movement end of action, they lie—as postures—not in the realm of mind but among the performances and accomplishments of the organism. If they are to be called "imageless," it would be better to admit that the adjective tells us nothing at all about the factors implied in their existence. It is unfortunate that the word "image" should have been used both for a *process of mind* and for all those remembered and imagined *objects* which do not depend upon the organs of sense. This ambiguous use has led many persons to believe that the facts underlying "imageless thought" are somehow descriptive of the mental side of the organism. The imageless thought is no more to be analyzed by the psychologist than the perceived tree or the remembered house or the object symbolically represented in the word. The analysis of meaning *never* leads to mental products. The primary task is to search out the resources, whether mental or physical, which create and produce the "imageless" meaning.[11] Two methods have been used. The

---

[11] T. Okabe, "An Experimental Study of Belief," *American Journal of Psychology* (1910), Vol. XXI, pp. 563*ff.*; H. M. Clarke, "Conscious Attitudes," *ibid.*, (1911), Vol. XXII, pp. 214*ff.*; Titchener, *op. cit.*, (1909); W. F. Book, *Psychological Review* (1910), Vol. XVII, pp. 381*ff.*

first is a direct inspective search in terms of quality; the second is a genetic inquiry into the history and origin of the condensed and abbreviated flash. These inquiries have led first to the discovery that, at least in some cases, the apparently simple flash is sustained by bits of primary and secondary qualities, as well as by appropriate movements and positions of the bodily organs and members. It has also disclosed significant processes of decay and foreshortening under repetition which help us to understand, by way of their history, the kaleidoscopic condensations which come ultimately to carry a disproportionate burden of meaning.

2. Our second observation concerns the distinction between the *reference* and the *indication* of mind. When we regarded the general contributions made to the psychosomatic functions, we saw that mind, on its side, (a) supplies meaning, reference, significance, and (b) indicates, gauges, or symptomatizes the state and temper of the organism. It is, now, this second indicatory prerogative of mind which we chiefly find exemplified in the posture. Just why the organism should, under thinking, fall into temporary and transitional postures and poses, be inclined one way and then suddenly inclined another, be keyed up and then run down, be suffused with emotion and set vacillating with indecision, we shall better understand when we have considered the character and the effect of the task or problem. For the present, we shall just accept the fact and observe that the postures "gauge" more than they "refer.". And yet they are more than a "gauge." There is a transfer from organic symptom to thought-comment. That is a part of the elaborative function. Instead of simply reporting how the organism is "held" or disposed, the posture marks the progress of thinking by a flash of doubt, a shade of indecision, a feel for the correct answer, a conviction that the alleged fact is true, a shock of surprise, and so on and on. Without the living total organism, sustaining these sudden and fleeting "states," which are reg-

istered in experience, thinking would be a colorless panorama of sequent stages without relevance and without issue. The gauge in its simplest and purest form is the affection, pleasantness and unpleasantness; but it appears too in the sense feelings, where somæsthesis also enters in characteristic ways, and it is present as well in those unaffective or neutral states which stand in thinking both for the bearing of the individual upon the issues of thought and for the integrations and relations which obtain within the thought-object itself. The "subjectivity" of feeling has always presented a paradox. In themselves the feelings somehow seem to be imbedded in the organism. They evince no articulation, no partition, no aggregation, no explicit reference, such as we find among the sensational qualities. Nevertheless, they are projected into objects by an empathic transfer and so seem to color and to qualify nature as well as ourselves. When we view the simple feelings along with all the other "vital indicators" which the complexities of life create, we get a clearer view of their generic functions in the organism. A reference to mood is informing. There the indicator runs on, coloring and tempering the whole field of experience. The individual may be exalted, buoyant, or disturbed for the hour or for the entire day. The mood thus indicates the way in which the processes of life are proceeding. It appears—except when we conceptualize it in terms of health or of bodily state—as the total tempering of experience. We may speak of this elaborative use of the vital indicator displayed in the posture as a *transfer* and add it to the symbol as a coördinate means of thinking. Where the symbolized meanings, which derive ultimately from sensational and (especially) sensimaginal sources, direct the thought toward its goal, under the guidance of neural trends and dispositions, the postures chiefly supply emphasis and comment, setting affirmation, denial, query, suspicion, and certitude at appropriate stages in the elaborative procedure. They announce, so to

say, from moment to moment, the position of the organism upon matters at issue.[12]

This indicatory aspect of mind, which appears in elaboration and elsewhere, compels us to extend our provisional definition of thinking by the phrase "and indicatory transfers." The flash-like turns and shifts of the organism are gauged or registered by these indications, which become transformed within the elaborative functions into posture-meanings. Since they are not objects employed symbolically, as words and picture-images are, it is simpler to call them "transfers" (organic states set over into postures) than "symbols." As we have just now seen, they serve as comments upon thought, standing for conviction, hesitation, inquiry, doubt, puzzlement, flurry, relief, advancement, retardation, check, and the like. When these transfers have been taken into account, our whole definition of thinking will then run: *a search initiated by a task or problem and carried on by the aid of symbolic meanings and indicatory transfers.*

2. *The Bodily Structures and Processes*

Although the body is engaged as seriously as mind is in the business of thinking, much less is known about its side of the coöperative function. Neurology gives us little beyond general schemata and conceptual constructions for our understanding of the cerebral processes. Not so much as a good working knowledge of the functions directly released by the stimulation of the receptor organ does it offer the psychologist; and when we advance to those central functions which are relatively independent of the nerves and which are sustained by the brain itself, we find our information to be still more meager. The most that we have to guide us toward

12 The attempt to bring mind and knowledge into relation to the totality of vital processes which we call "life" appears in Bergson's doctrine of the *élan vital* and in the Freudian *libido.* Any empirical psychology will dispense with the hypothetical faculties and powers which are proposed in both of these speculative systems.

the bodily resources in thinking is derived, on the one hand, from a general theory of the interaction of neuronal systems and, on the other, from a transcription of the facts of memory and association into neurological terms. When we turn to the various forms of behaviorism, which profess to write, in terms of "stimulus" and "response," the functional relations of the organism to its surroundings, our knowledge is not greatly extended. Unless we are content to leave out of account the whole procedure of thinking and to confine our description to hypothetical movements of the throat and larnyx and to regard these movements as responses to environmental change, we are left in the dark as regards the essential part played by the brain in the initiation of the thought-task and in the operations involved in its solution. Our survey of the mental materials involved in thinking does not substantiate the behaviorist's contention that thinking is confined to language and still less to vocal speech. Were thinking indeed confined to trains of vocal movement, the attempt to work back from laryngeal innervations to a "thought stimulus" would be like a correlation, item for item, of the sands of the sea-shore with the topography of the mountain chain long ago eroded and pulverized; like a search in the cistern for the pattern of raindrops upon the roof. The *intermediate* events, the very facts which make description coherent and significant, would be ignored.

Our first reliance is upon some form of integrative central function which leaves the brain disposed toward future redintegration. This disposition is assumed in our formulas for association and for "conditioned" and habituated functions. Although no one knows precisely what central integration and central disposition are, the facts of mental organization (*see* Part II) obviously call for such a conception. When we go beyond the train of associated members and consider the operations of thinking, we find Kries's "connective disposition," a total functional preparation or *Ein-*

stellung, and Ach's "determining tendency" valuable aids to a comprehension of the cerebral functions. Setting out from the facts of thinking, Kries drew the inference that a central integration, such as is set up in a perceptual train, not only tends to complete itself when it is subsequently initiated, reinforcing itself internally, but also that a part of it when renewed tends to set into readiness outside functions which stand related to any part of it. Thus *a* or *e,* elements in any total function (*abcdef*) would strengthen any element, as *m* or *q,* which had stood in a function (*mnopqr*) related to it. This proposal of a *connective disposition* (an anticipation of the "conditioned reflex") takes us beyond the individual reproductive tendency and helps us to understand such highly synthetic functions as we shall presently discover in thinking. Ach went further, assuming that there were functional trends of a peculiar kind, closely related to "will" and "purpose." These are his "determining tendencies," which we found useful in the study of action and which have been widely employed in the psychology of thinking. These anticipative preparations for function in the nervous system are assumed to be released when the individual forecasts a bodily movement (idea of end) or entertains a task for thought. In the one case, the tendency sets the organism toward the appropriate movement; in the other, toward a solution by way of symbols. Both of these conceptions have been extremely useful, for they point to the fact that the living organism does not drift from occasion to occasion, merely following in the wake of external events. On the contrary, it is, in certain of its functions, directive. It is not wholly at the mercy of the stimulus or of metabolic change. It moves toward ends or goals. To acknowledge this fact is not to admit a mysterious vital force or entelechy or a peculiar power of will or purpose. The determining tendency is designed to replace these speculative terms. It may be used to designate only those highly integrated functional connections

within the nervous system which provide that a fixed train of reproductive processes shall be sustained and shall in turn release other neural processes at certain stages in their course. We cannot do much more than translate into neurological terms, under our general knowledge of the activities of nervous substance, the facts of psychological observation. The notions of direction and preparation are to be saved for empirical science by substituting history for teleology. The determining tendencies have, of course, been fashioned in the individual's lifetime under the same natural laws as provide for the individual reproductive tendencies and for the simpler functions of perception, memory, and impulsive action. The difficulty of making the history of the determining tendencies definite and circumstantial is due to the enormous complication of structure and of organic function. At present our best and safest approach to them is through such systematic and empirical researches into psychosomatic functions as are to be found in the experimental studies of association and of the "course of ideas." [13]

Experimental Instances Taken from the Laboratory

We shall do well to review one or two of the simpler elaborative problems which have been worked through at length in the laboratories. Suppose in the first place that you read the sentence, "The wren is a bird," or "The building has windows." That is for you, as you now read, a simple matter of comprehension. You are informed and you understand. Either sentence makes sense. So far there is no "thought," in our meaning of the term; because you have no problem and no solution. But now, in the second place, suppose that you are given the following instruction, "I shall call out the name of an object and I shall ask you to respond with the name of the class within which the object falls."

[13] *See* appendix, p. 533.

Then I, serving as experimenter, pronounce "wren" (technically called the "stimulus-word") and you respond with "bird" or "animal" or "flyer" ("response-word").[14] Again I instruct you, "I shall call out an object and I shall ask you to respond by naming some part of it." Then I pronounce "building" and you respond with "window," "door," "floor," or "room." If the response is the conjoint issue of task, stimulus-word, and an associative formation which involves symbols, you have *thought*. You have entertained and resolved a problem. For you the verbal formulations "The wren is a bird," "The building contains windows" are the outcome, the product, of thinking. Had you answered "bird" to "wren" and "windows" to "building," but without the task, there would have been no thinking. From the experimental use of a wide variety of tasks of this order the psychologists have derived the following facts about the operations which take place in these simple cases of thinking.

To begin with, the undestanding of the stimulus-word in the light of the task (*e.g.*, "wren," to find the class) is accompanied and followed by "reproduced" qualities and constellations. These latter Watt found to carry the meaning of (1) a visual image (as of a bird), (2) a word (such as "little" or "perch" or "flying"), (3) a flashing posture, or (4) the response-word. Where the intermediate meanings

---

[14] The experiment is known as a "reaction with limited association." Where the task is supplied by the experimenter it is technically known as the "instruction." Of course, in ordinary thinking outside the laboratory, we set our own tasks or they are proposed to us by some object or event which catches our attention and piques our curiosity. In experiments the formal instruction prepared by the experimenter helps to standardize the procedure. As a rule the time between the two words is kept by suitable means. Significant inferences regarding thought are sometimes to be drawn from the elapsed time. The term "stimulus-word" can be justified by usage only. For the proper use of "stimulus" as physical agent *see* p. 45. It would be better if "stimulus-word" were dropped altogether by psychologists.

(1, 2, and 3) appeared, the response sometimes came directly with them and sometimes later. The duration of the solution depended both upon the nature of the problem (*i.e.*, to find a class, an individual representative of a given class, a whole, a part, a coördinate class, or a coördinate part) and with the character of the intermediate meanings. At times the procedure was complicated by two or more associative trains. Here a response-word was either definitely rejected as unsuitable to the problem or else the observer groped for a certain elusive word. These cases show clearly the effect of the task upon the associative course. As for the task itself, inspection frequently failed to reveal it when, and after, the stimulus-word was understood. That is to say, the fitting response-word was frequently given when the task was understood from the instructions before the stimulus-word was exposed but then dismissed. This discovery concerning thought is of great importance. It shows that elaboration may proceed although the mental aspect of the task has lapsed. We are led to assume that the final guidance to elaboration is, in this case, physiological. That is one reason why thinking appears so thin; why inspection reveals so little that is characteristic of our logical constructions

The elaborative function falls, as we have seen, into two stages; the first stage is the positing of the problem, the second the search for, and the discovery of, the solution. In the reaction experiments with limited response, where the observer has to specify a general class, an instance, or a part, we have a good opportunity to separate these two stages, which are in our everyday thinking more or less commingled. In the preparatory period, the thinker is given his task through instruction; but he cannot solve it until the stimulus-word (as "wren," "house") has been presented. After the stimulus-word is given, he performs his task and responds with the appropriate word. Thus are task and solution divided by experimental means.

The Task

First we seek a psychological description of the task-setting stage. Here the adage "Well begun is half done" is forcibly exemplified. Thinking is well on its way when the problem has been clearly formulated. In the naïve and unpracticed observer we commonly find a voluminous commentary on the task, which represents an effort to grasp the problem. When put into words the commentary runs something like this: "I am to name a general class. For example, if he says "geranium" I shall answer "flower," if "salmon" "fish," if "water" "liquid," etc. Always something which *includes* . . . a container. . . ." Besides words, such things as picture-images, diagrams, gestures, geometrical figures, and vague kinæsthetic place-designations may be symbolically used to set the task; but upon frequent repetition this task-positing period will suffer foreshortening and simplification. No longer are the conditions argued out with instances. The character of the task is comprehended briefly but clearly. Ach found in it (1) scanty sense qualities, visual (from the perception of the screen where the stimulus word was presently to appear), tendinous (bodily preparation), and auditory-tendinous (words); (2) an "imageless awareness" (*Bewusstheit*); and (3) a physiological set or preparation, the determining tendency. The awareness was flashlike; but it meant, as Ach thought, four different things: (a) "the word is coming," (b) "I am to do something," (c) "there will be a relation between stimulus and response," and (d) "the stimulus will come soon." Thus the determining tendency is for Ach an adjustment for a determinate neural function. It is to be added—he argued—as a third bodily factor to the reproductive and perseverative tendencies of the associationists. It is engendered in the nervous system under the influence of the goal toward which the thought-problem moves, and it is responsible for the appropriate

response when the stimulus-word is presented. It is a "solving" device of the organism which obtains its effectiveness by a selective action upon reproductive tendencies. Thus "bird" comes out because the instruction, "find the class to which the particular object belongs," has set into commission the "class-finding" determining tendency.

Finally, as regards the task-positing stage of thinking, we must recognize those cases—exceedingly common in all the fields of scientific research and of constructive writing—where the statement of the problem is itself the outcome of previous thinking and previous comprehension. If you will revert to the first hour that you spent upon the present chapter, you will realize that then the topic of thinking was not at once a real problem. Until we know something about a subject it cannot appear to us as problematical. See how many of the following phrases suggest real problems to you; the law of three bodies, the electrical constitution of the atom, the general relation of pressure and density, the apparent exceptions to the periodic law of atomic weights, the cataclysmic theory of geological change, the relation of supply to demand in economics, the origin of the vertebrates, the explanation of semantic changes in the history of language, the doctrine of goods and of valuation, the rate of neural transmission, the use of the ether in physics, and the origin of man. No one of these subjects of research becomes a true task for thinking until long acquaintance with many facts has made it possible for the individual to conceive the need of a solution. Men prominent in the sciences have been men who discovered problems where others moved without question or curiosity.

The Solution

Now we approach the second part of our description. What is elaboration itself? How is the task, once set, resolved? Again we go to the experimental literature and

there we discover that the means to solution are many and various. The key to all of them, however, lies in the task itself. It is not difficult to see that there is a *logical* relation between task and accomplishment; but we must also understand that the relation is psychological as well, *i.e.*, that the resources of the organism in thinking are really thrown into commission during the first stage. As we have seen, so long as men simply observed the solution itself, they found next to nothing by way of "contents." Mind seemed to be particularly "empty" even while important conclusions were being reached. We must, then, scrutinize the task. That is because the procedure of solving has necessarily to be prepared for and initiated by antecedent processes. That is the meaning of our earlier remark that thinking is always a "prepared" function. Let us see how the influence of the determination under the task is exerted. There are three cases.

1. The task previously set *reappears* when the occasion for solving comes to hand. Suppose that the instruction runs, "Name a class"; that the task is assimilated as we have suggested, and that then, upon the appearance of the word "wren," the thinker says to himself (though the meaning does not necessarily come through verbal symbols), "What class can I give for 'wren'?" That instance would be paralleled outside the laboratory by the discovery of an unknown rocky stratum, while upon a geological expedition, and the attempt to identify it as a granite or limestone or schist. From the experimental studies we have learned pretty exactly how the organism proceeds. The restatement of the problem (as when the word "wren" has been given) heads toward the solution by three different routes:[15] (a) The response-word,

[15] The reader must constantly realize that verbal symbols are used in these illustrations only because they are communicable, and that the actual meanings present in thinking are frequently nonverbal.

as "bird," "animal," "flight," or "winged-creature," is immediately given by associative context. Put into words, we have:

Occasion → *Task* → *Solution*
"wren" — "what class"? — "bird"

Here the function of the task seems to be simply to facilitate a topical constellation which has been established and consolidated by numerous experiences with birds. (b) In the second place, the task may serve to supply a special device. Suppose that the word presented is the nonsense syllable *zim* and that the instruction is to rhyme. There the task suggests that "another initial letter will do it." *F* comes and *fim* is pronounced.

Occasion → *Task* → *Device* → *Solution*
"zim" — "rhyme it" — change initial — "fim"

To this experimental case corresponds such a thought procedure as tapping upon the interior finish of a Pullman car in order to discover whether the structure is "real wood" or steel.

Occasion → *Task* → *Device* → *Solution*
"this grained finish" — "is it wood?" — tapping — "steel"

(c) Once more, a successful device may come in time to be automatically used when the task is presented. Thus the instruction to "name a part" may succeed by repeating the stimulus-word and compounding it with some other; as "knife—knife blade," or "table—table-leg." After a time, the device may wholly disappear from the meaning of the task and nevertheless be effective for the solution. When it does the device exists only as a specific neural set or *Einstellung* (as the technical term is).

Occasion → *Task* → *Solution*
"knife" — "name a part" (*Einstellung* to complete) — "knite blade"

This procedure accords with the hammer-stroke upon the wheels of the limited train at division stations to discover cracks or defects—except that here habituation still further automatizes the procedure of the skilled workman and reduces the formulated problem itself. Probably the workman "thinks" only when he is arrested by a "cracked" sound and begins to explore.

Observe that in all these cases the symbolic meaning plays its part. The determination represented by the task may lead immediately either to structures carrying a verbal meaning or to some substitute for words.[16] A frequent form of vehicle (though by no means invariable) is what we may call the "super-symbol" or "concept." So far as the operation is concerned, the case is the same.[17] The difference is that the concept stands, not for an object or an example, but for an entire abstracted class.

2. We come now to those tasks where the *occasion* for thinking *does not revive the original task;* where, instead, the antecedent task has provided a *suitable mode of procedure* which effects the solution. This mode of procedure serves then as a substitute or surrogate for the task. Here are instances. When the observer is instructed to "name the number or digit which comes next before the number to be presented," he provides, in visual or motor imagery, the whole series 1 2 3 4 5 6 7 8 9 0; then, when the number (say "7") appears, he reads off quite automatically on his imaginal scheme the first to the left ("6") and the task is solved. He

---

[16] Logic is easily misled by the formula; "a verbal proposition, therefore a judgment, therefore thinking." If the answer to a query (*e.g.*, "Has my tire gone flat?" "Did the razor cut my face?" "Is the train coming?" "Is the coffee hot?") comes by way of perception (an immediate apprehension) then thinking does not occur.

[17] Psychologists have tried, but without success, to discover in the "concept" an unique kind of mental "process," or "act of thought." (*Cf.* Dürr in Ebbinghaus, *Grundzüge der Psychologie* (1913), Vol. II, pp. 264*ff*.

does not first revive the original task and then look for the appropriate number. The "7" takes him immediately to the corresponding part of the scheme where he finds "6."

Task ⟶	*Occasion* ⟶	*Surrogate for task* ⟶	*Solution*
"name next before" *i.e.*, 1234567890 ←	"7"	1234567890 ←	"6"

What seems to be prearranged here, in the task, is a shift in clearness along a conventional scheme representing the natural order of the digits. A way-of-doing or a method of proceeding is provided in advance of the concrete event. This ability of the organism is of enormous importance. It signalizes the trained thinker who has besides "knowledge" (*i.e.*, a ready supply of relevant associative tendencies) the control of methods which he applies as occasion demands. He knows in advance how to attack the problem; and the result is that the associative materials appear "as of themselves" when the need arises.[18] Thus when Müller was instructed to "subtract the right-hand figure from the left" he provided that attention should be directed to the right-hand figure (whatever it should be) and then to the left. Subsequently when "8 | 3" appeared, he immediately (*i.e.*, without reviving the instruction) called out "5." The concrete materials employed in such a bit of preparation (whether visual, auditory, somæsthetic or mixed) would depend upon the type of the observer. The effect is to provide an associative connection which shall lead to the proper solution. The strength and efficacy may derive from its recency or its frequency. Other devices of the same sort which have been detected in the experiments are the provision of an × where the instruction is to "multiply" or of an "in" where a part is to be

[18] The possession of these methods of procedure have an obvious bearing upon the question of "transfer of training."

given and a whole named (*e.g.,* "tree"—(in) ⟶ forest; "car"—(in) ⟶ train). In these cases the direction in which the associative completion is to move to provide materials for a solution is prearranged and so the appropriate neural processes are held in readiness instead of the original task. How cleverly these devices may indirectly work toward solution is shown by those instances where the instruction to "name a part, given a whole" led to the plan of visualizing the object named and attending by abstraction to some part of it.

Task ⟶ *Occasion* ⟶ *Surrogate for task* ⟶ *Solution*

"name a part"

↓

(self-instruction =)

"Visualize the whole and attend to some fraction of it" → body ⟶ free image of human body

↓

arm observed — "arm"

Here the imagined body is really substituted for the word "body" and the attentive designation of a part of it becomes a secondary task. The same procedure may be used for naming a whole when a part is verbally given; only here the visualized part (*e.g.,* leaf) is extended to the entire object (tree), which leads to the response-word ("tree"). We see that the subject has solved *his own* task when he has identified the arm (or tree) of the imaged figure; but he solves the *experimenter's* task only by expressing the verbal term "arm" (or "tree").

3. Finally we have the paradoxical case of a *solution without a problem.* The experimenters found that the frequent repetition of a task—arising (say) from the instruction to "name a class, given a particular member of it"—led at times

to an immediate solution without the presence of the task, without even a device at hand, or a substitute, or so much as an intent to solve. The observer simply looked at the exposed screen with a mild expectation (visual-strain complex), and when the stimulus-word appeared the response-word followed as of itself.

Task	$\longrightarrow$	*Occasion*	$\longrightarrow$	*Solution*
"name of class"		"elm"		"tree"

The problem had literally been shunted out of sight. Here the function which was, under case 2, initiated by a secondary task appears without any preparation and runs smoothly through to a solution. This seems to be the same kind of a fixed set toward a specific function as we find in descriptive writing, where visual or auditory imagery appears, quite without intent, to embellish or to enliven the meaning. It may be compared also to the automatic tendency to name objects or to supply appropriate words when once speech in a foreign language has been undertaken. In all these cases the set or *Einstellung* is toward a way-of-doing rather than toward the arousal of specific instances. We are all familiar with this generalized modal tendency in movement. The graceful person is generally graceful; the skillful person apt and economical in all his movements. It is, however, a very distinct advance in our understanding of the elaborative functions to find that in them, too, the organism is able to acquire *ways* of thinking which may take the place, on occasion, of the special preparation of devices and means forming a task or a surrogate.

Is the Problem Necessary to Thinking?

Thought without a problem does sound paradoxical. But we resolve the paradox either by denying that this automatic carrying out of the instruction is thinking or by observing that the problem is wholly somatic—a neural preparation

without mental constituents. Most psychologists who have really thought through the problem of thinking (not a very large number!) have preferred to regard it as a form of thinking, but thinking with an "unconscious" task or neural determination.

Now there is nothing to be gained by a dogmatic denial that the physical organism can upon occasion do anything which tradition or prejudice have regarded as a prerogative of mind. We certainly cannot carry through a descriptive psychology of thinking in purely mental terms. The body is obviously concerned at every step. But with task and symbols both gone in this troublesome Case 3, can we consistently retain our original conception of thinking as the "solution of a problem in symbolical and symptomatic terms"?

A reference to action will be instructive. There too we found that repetition led to condensing and to short cuts. Under habituation the typist, the pianist, and the tennis player accomplish by small means and in an economical way what was first carried through elaborately and at great length. Purposive action slides into impulsive, impulsive into psychomotor, and psychomotor into a "derived reflex." We cannot say at the end of habituation that the performer selects his keys or his strokes or that he deliberately considers how he is to proceed. Can we any more consistently say that in Case 3 the subject thinks out his problem? The same end but different means! Here no problem and no symbols, just as in the automatic action no deliberation, no purpose, and no selection. We might speak of "degenerate" or "decayed" forms of voluntary action and of thinking; but facility, promptness, and accuracy are not marks of degeneration. They are marks of skill and aptitude. And since we are considering our psychosomatic functions as ways-in-which, not as outcome and product, we can scarcely bring this elliptical attainment of the organism, without problem and without symbols, under real thinking.

At the same time, it is important to find that the organism is capable, under suitable preparation and tuition, of arriving at new goals and of acquiring new products by methods of shorthand. It appears that the transcendent accomplishments of genius are due in large measure to condensations and ellipses on a large scale which reduce the elaborative procedures to their lowest terms. "Intuition" frequently means only defective observation of the rapid progress of thinking —an inability to catch the problem and the device for solution; but in its best sense it means the immediate arrival at significant ends by the same sort of economy as we find in our "automatic" solutions.

The experimental instances of thinking are usually simple. Often they seem to be trivial. Neither do they, in every case, supply the thinker with knowledge which is entirely novel. For example, the subject "knew" (in Müller's sense of "potential" knowledge) before the word "wren" was exposed that the wren was a "bird." Nevertheless, these simple experiments, with their searching inspections, have given the psychologist a deeper insight into the way-in-which thinking goes on than had centuries of reflective and logical construction.

Everyday Instances of Thinking

Let us see how far we can apply the knowledge which we have derived from them to such familiar and common instances as we might take from thinking in the streets, in a collegiate examination, or in such a practical matter as the attempt to discover why the right front tire of a car wears out more rapidly than its mate. Do these everyday instances of thought, which certainly seem more illuminating and less stupid than the simple word-reactions of Watt and Ach, contain anything not essentially contained in the experiments?

So far as the task is concerned, minor differences at least appear. In the experiments, the problem is "given" to the

subject by means of the instruction, "You are to do so-and-so"; but outside we do not so much borrow as "make up" subjects to think about. Surprise at finding that the new tire must be bought, when we had expected the old one to wear another season, may well be food for thought; likewise, the shedding of the leaves in autumn, mentioned before. Sometimes we say of a person that he is "thoughtful" in the sense that he is always turning up new problems for solution. He has "intellectual curiosity." He constantly wants to "know why."

Of course—as our discussion of comprehension taught us—many problems are solved without real thinking. "How were the battle lines formed at Vimy Ridge?" "Why is my neighbor's car standing so long at *his* neighbor's door?" "What can I procure for the family luncheon within an hour?" These problems are real enough; but they are solved, as a rule, without elaboration and without symbols, *i.e.*, without thinking.

Questionable Instances of Thinking

Neither does "abstraction" (which is a certain kind of partial apprehension or understanding) commonly fall under thinking. One may, to be sure, come by way of elaboration upon an abstractive view of an object, *e.g.*, the composition of the earth's filling or the chemical ingredients of the chromatin threads; but that is only because perception and comprehension meet with insuperable difficulties and call for real thinking. But mere departure from the whole concrete object does not necessarily—or even usually—demand thinking.

An interesting case of real elaboration is shown in certain "abstraction" experiments where a colored figure of irregular shape is briefly exposed to view. The subject is informed in the instruction that a group of figures (say 4) will follow, differing in shape, size, position and color, and that in one of them

he is to identify the *shape* of the figure first exposed. The task to identify is not resolved by simply carrying in memory the figure just perceived, but by using that figure symbolically to represent a given "pure" or abstract shape. Here the shorthand procedure of elaboration is attained by casting out the size, color, and position meanings, which make the concrete perception, and by identifying another object as "that shape."

Nor does that conceptual meaning which denotes a class or species (as "man," "animal," "beauty") necessarily involve thinking. It belongs rather to a mode of comprehension; although, again, the concept may be either an instrument or an issue of thinking. In fact, many of our most familiar concepts are frequently used in, and modified by, thinking, as we shall presently see. As for the concept itself, considered apart from its use in logic, it is simply the most refined and the most inclusive of the secondary meanings or symbols. Instead of referring to a simple apprehendable object (as "Luther McIntyre" or "New York City"), it means either a certain kind of object or event (beetle, star, fishing, running, swimming), or an assumed force, condition, or agency (energy, field of force, life) which may never have been itself experienced, but which helps us to understand, discuss, and "think about" our existence and the world in which we live.

Again, a cursory survey of the chief problems of reading and writing was sufficient to inform us that that verbal construction which the logicians call the "judgment" is not—at least in its common forms—a mode of thinking. The primary and common function expressed in the judgment is either (1) a concrete perception ("That tie is a brilliant red." "This water looks cold") or (2) the comprehension of a meaning conveyed from a speaker or writer ("For he is free to whom all happens agreeably to his desire, and whom no one can unduly restrain." "This world was once a fluid haze of light"). In the latter kind of judgment the intent is to

clothe a topic with some one's meaning. The function left to the reader is to *understand*.

When we advance from the task to those procedures which lead toward its solution we find—so far as our present psychological knowledge takes us—the same kind of elaboration in common life as the simpler experimental instances have revealed. A task sets in train those mental structures and those physiological sequences which lead toward solution. Every resource is bent toward the creation of a *meaning*, which *is* the solution; and toward the psychosomatic attitude which *is* the *conviction* or the *acknowledgment* that the solution fits the problem. Just as movement and the organic state which succeeds it relieve and discharge the determining tendency in action, thus bringing it to a fitting close, so does the *posture* or *indicator*, which is tuned to the thought-task and released by elaboration, give notice that the problem has been solved and the question answered.

As regards the function of the task in the solution, our three cases discovered in the experiments reappear in our common thinking. (1) First, the task may run through the solution. This case is common where the formulation of the task is novel and first-hand. When I observed last week the early wear of one of my front tires and asked "why?" I straightway attempted a solution, maintaining the task meanwhile and refreshing it by comment: "That is curious!" "Strange, isn't it!" "How can that be?" I examined the wheels, the road, the curb and the driver's view of the track (perception). I recalled what I had heard at garages and tire stores (memory). I imagined myself driving, turning, backing (imagination). I enriched the topic "wheel-wear" by associative material (comprehension) until finally I hit upon the solution: "The right wheel runs over rougher ground at the edge of the road, bumps curbs, and gets more lateral thrust from the 'crowning' of the roadway." There the query sustained itself until the end, where task and elabora-

tion were discharged together. (2) Again, our task is transformed into a device for solution, the device standing as a surrogate for the original problem. This is our case of the tapping of the interior of the Pullman car. Instead of the original problem, "Is it steel or wood?" we have the self-instruction "tap it," relying upon the sound to arouse the verbal associate "a wood-sound" or "the ring of steel." This method of thinking is common in classificatory science. The taxonomist who is intent upon the identification of a specimen may replace the original task of classifying by an intent to notice the venation of the wings or the structure of the mandibles. Finally, in (3) the problem lapses on the mental side, being sustained by some unobservable physiological trend, and the solution springs out unheralded, as when the skillful surgeon gains new anatomical knowledge while he attentively operates. Always the organism is prepared. It is charged. A problem has at some time been formulated; at least partially. Now the ordinary issue of elaboration appears; although the functional antecedents are wanting both in mental ingredients and in symbolic meaning.

The Labor of Thinking

We should acquire a wrong conception of our subject were we to get the notion that the course of true thinking always runs smoothly. A critical scrutiny at first-hand will reveal all manner of failures, half solutions, delays and reformulations. It is probably the exception rather than the rule that a really new thought-task should immediately, by its initial determination, supply all the resources necessary to a complete and unimpeded elaboration. Such instances as Newton with the falling apple and Galileo with his swinging lamp are doubtless fictions of the logician in so far as they pretend to show the direct and immediate march of thought to a new solution. At the most, they are, in all probability, only final formulations behind which stand months or years of incuba-

tion and abortive attempts at discovery. Outside the laboratory the task itself is very often not given in as clear-cut and definite terms as it is in the experiments and thus requires many successive attempts at clear formulation.

But while the formulation of our serious thought-tasks is often much more laborious and complicated than the simple experimental instances, the procedure appears to be similar. The combined functions of apprehension and understanding clarify the materials at hand, and this clarification strengthens reproductive tendencies which perfect the meaning of the task. Consider an instance taken from daily life. I visit an institution designed for the care of defective children. Upon entering I vaguely apprehend that I am facing a new problem. I converse with the superintendent, the physicians, examiners and attendants. I visit the wards and cottages. I distinguish the moron, the idiot, and the child suffering slight enfeeblement of the psychosomatic functions. I watch the inmates at play, at work and at table. I note the wide variations of movement, expression, and physical deformity. I consider history, family, reasons for commitment, and custodial provisions by the state. Gradually is enriched and consolidated the topic "condition and care of defectives," and out of it, through perception and understanding, emerges the problem, "What is the obligation of the state?" If the case were the same as the indeterminate problem of arithmetical computation, one would simply search among existing "ready-made" formulas. "How care for the criminal?" "How dispose of the insane?" and the like. But this sort of borrowing is impossible because of the richness and the particularity of the topic. The next step is the use of an old solution, "Why worry! Plato has solved the problem in his ideal republic," "Let families muddle along with their unfortunate offspring," "This plan seems to work." It is obvious that this procedure (common enough in such predicaments!) only avoids thought. The problem is killed

before it is really formulated and faced. Let us take the position that the topic conceals a thought-task and honestly try to formulate it.[19]

Notice first that the problem comes out in general and fairly abstruse terms. This result is common where the topic is rich and many-sided. Such topics call for abstraction and for the use of our super-symbol, the concept. Without such aids we should be lost in a wilderness of perceptual details and of associative trains. The individuals observed are regarded as examples or typical instances (exemplificatory perception). The perceiver abstracts from all those aspects of the patients which serve only to make them multitudinous and cumbersome; so also the cottages, the kitchens, the attendants, and the officers. On the other hand, the concepts of "state," "public resources," "legislation," "duty," "social hygiene," "disease," "mental defect," and "inheritance" are necessary; not only to an apt and competent solution but to the very formulation of the thought-problem itself. A practical demonstration of this dependence is presented by the history of public custody and care. The more clearly the public (or that small fraction of it which thinks) has been able to sustain its relevant concepts, the more aptly and intelligently has it been able to conceive such problems as the nature of psychosomatical defect and civic responsibility.

A similar analysis might be made of persistent and fundamental problems of the sciences. Generation after generation the sciences repeat the question, "What is life?" "How is matter constituted?" "How does the fertilized germ-cell develop?" "What historical relations do animals sustain to

---

[19] The reasons why men cast around for problems to formulate suggest a psychological inquiry of unique interest. Some of the most obvious reasons have stock names and they can be counted off on the fingers: "intellectual curiosity," "conscience," "imitation," and "practical necessity." Pillsbury takes the problem lightly, reducing every sanction to "necessity" which, as he opines, is the "mother of all thought," *Fundamentals of Psychology* (1922), p. 424.

each other?" and the like. Although the formal statement of the scientific problem may remain the same, its actual import grows with the enrichment of the topic through new knowledge and with the conceptual refinements which improve our understanding of "life," "animals," "matter," and the rest.

It frequently happens, of course, that the factual materials for inventing the task are not always so easy of access as in our case of "custodial care." Generations may struggle blindly toward the statement of a problem (*e.g.*, "What is the nature of the apparent attraction of one body for another?" "What is the relation of seasonal change to the earth's motions?") until new facts and other solutions have made a clear formulation possible. It not infrequently happens that obfuscation is increased and a clear formulation delayed by emotion, magical belief, ardent desire, and prejudice.

The inaptitudes, the delays, the obscurities and the half-successes of the elaborative functions have led some writers to declare that thinking is a stumbling and half blind process of trial and error.[20] This view is too extreme; it overlooks the fact that, in spite of its limitations in reaching *correct and useful* conclusions, thinking is a determined and directive approach, by way of a formulated task, to an anticipated and desired solution.

The Uses of Thinking

The benefits of thinking proceed naturally from the character of the elaborative functions. Thus to entertain a thought-problem we must pass beyond mere apprehension, whether of things absent or present, beyond action, beyond comprehension itself, to regard the significance of things.

---

[20] So Pillsbury writes of inference as "a process of trial and error. . . . Persistence is the only virtue; the rest is very largely a matter of chance," *Op. cit.*, (1922), pp. 427-428.

1. In the first place, thinking brings us new knowledge, *i.e.,* knowledge of a new order, significant relations and hidden resemblances—in a word, knowledge which is *insight.* Of course, the single individual acquires directly by thinking only a small part of the store of knowledge. Larger stores he acquires by way of comprehension from the thought of other men. But without thinking his comprehension is straitly limited, and his critical estimation of facts and theories is without value.

2. Because of the abstraction of thought from the concrete object and the particular occurrence, the individual is carried beyond the fixed orders of space and time, the immediate stage-setting of life, to a more comprehensive view of the universe. This freedom from the fixed order gives *foresight.* The thinker outruns time. The present and the past are not only succeeding acts in a drama; they signify that which is to come. So man by thinking anticipates the future and provides against it by building cities and railroads, by cultivating the land, and by contriving an enduring arrangement of social and political relations. "A savage," says Dewey,[21] "who has been shipwrecked in a river may note certain things which serve him as signs of danger in the future. But civilized man deliberately *makes* such signs and sets them up in advance of wreckages."

3. Insight and foresight together lead to *valuation.* The abstract regard of human relations and the anticipation of human needs lead to the estimation of objects and acts as good or bad, as right or wrong, as praiseworthy or worthy of condemnation, as true or false, beautiful or ugly, important or trivial. So man adds values to his world of objects and occurrences.

4. Finally, thinking furnishes a kind of *training* not otherwise supplied. We saw that, even in simple tasks, the solu-

[21] J. Dewey, *How We Think* (1910), pp. 15-16.

tion of one problem helps in the solution of another; that the exercise of function leads to general methods which remain for new problems. To put the matter in more general terms, thinking adds a new power both by way of new knowledge and by the acquisition of methods which propound and solve future problems. Without fixed habits of thinking the judge is a mere partisan or a mere sentimentalist, the legislator a mere echo of political opinion and the scholar a mere transcriber of borrowed thought.

The benefits of thinking, then, are great; but they are to be enjoyed only by hard labor. Thinking easily goes wrong. The illusions of the senses, through inadequate perception, we soon learn to correct; but the use of symbols is a delicate business requiring high powers and the cunning use of means and devices. When we consider these intrinsic difficulties and also the natural bias of wish, desire, and current opinion, we can at least vaguely understand why false doctrines, magical explanations, and superstitious beliefs flourish in spite of centuries of science. We must then agree with John Locke that thinking requires great care "to conduct it aright in the search of knowledge."

The Question of a Valuating Function

So much of our commerce with human beings and with nature rests upon the pronouncement of values that the common assumption of a special "valuing capacity" or "power" should not surprise us. Constantly we "judge" objects, persons, principles, and systems. These judgments are pronouncements of worth. How are they made? When we value, do we do something distinctive? Is there a fifth functional mode which provides for the setting of things up or down, for rating them as higher or lower, for prizing and disprizing them, for labeling them as objects of great or of little worth?

The first important fact for the *psychology* of value

(leaving aside all attempts at classification of value and all matters which pertain to morals, æsthetics, logic, and other special systems) is the obvious fact that a value is always an aspect of *meaning*. The value-meanings belong in a class which is coördinate with the existence-meanings. I perceive the tree as existing and as displaying certain existential attributes, greenness, height, spread, etc. I also perceive it as symmetrical, graceful, and badly placed. These last meanings of the tree "value" it; they mark it up and mark it down. But they are tree-meanings as much as the others. In a similar way, the conviction of truth comes out of an operation of thought as naturally as a new relation or a new law comes. What is still more important for our present discussion is the fact that the value-meanings are derived through the same functions as our thoughts, topics of information, coördinated movements, and objects of apprehension. That is to say, we *perceive* and *imagine* values, we acquire values by *action* and *emotion,* we *understand* values through topical inquiry, and we *think out* values by the use of symbolic means.

Those who hold to a "rational," an "emotional," or a "sensuous" theory of value are likely to overlook the fact that *all four* fundamental functions are laid under levy in the creation of the valuational side of the world. Music and the fine arts would hardly prosper without apprehension, or dancing, sculpture and pantomime without action. The art of prose composition rests in part upon comprehension, and no first-hand discovery of moral or æsthetic order succeeds without thinking.

A fuller account of values than is feasible in this place would distinguish such psychological classes as (1) *false* valuations, which are taken on trust or else at the dictate of custom, fashion, or some other convention, *i.e.,* borrowed values, without appreciation and without proper problem or task; (2) those *spontaneous* valuations, which rest upon

special predispositions and valuing postures or *Bewusstseinslagen* and which are gradually consolidated and systematized under cultural conditions; and (3) those *reasonable* values which are wrought out under the tasks of understanding and thought. The discussion of these classes would lead us to set the "rational" element in valuation in its true relation with those "vital indicators" which we have found to exist in their purest forms in the affective and emotional aspects of experience.

CHAPTER XVI

ANTECEDENTS OF THE FUNCTIONAL OPERATIONS

Are the Psychosomatic Functions Adequate?

Our account of the four great types of function has covered a wide range of psychological fact. A very large part of the writing of the last fifty years falls within it. But the thoughtful reader will have noted its limitations. There remain a great number of common performances of the organism which would seem to stand in an ambiguous relation to these functional modes. When we run over, in terms of accomplishment, the experiences of the day, many of them appear to stand outside our major operations. Consider the wide variety of our daily accomplishments. We distinguish, identify, recognize, recall, and scrutinize; we ponder, plan, group together, and search out; we add, subtract, equate, transpose, prove, and demonstrate; we try, fail, succeed, hope for, wish, and desire; we read, write, draw, learn lessons, do exercises, translate, and transcribe, and we walk, run, make skilled movements, and construct. How are all these and many other common pursuits and deeds related to the four modes?

A good many of them we have, of course, accounted for; and many of the others are conceived in terms of the end-result—a conception of "function" which we deliberately avoided because it promised to lead us to final products and not toward psychological means. Nevertheless, something remains to be added. That something is the statement of conditions under which the functions are initiated. This quest of the antecedents of the psychosomatic functions has

been one of the most important tasks of the psychologist within the last twenty years. It is the psychology of predisposition, of set, of instruction, and of *Aufgabe* or *problem.* We have referred constantly to it in the preceding chapters; but now we must regard it more generally, in connection with our entire functional study.

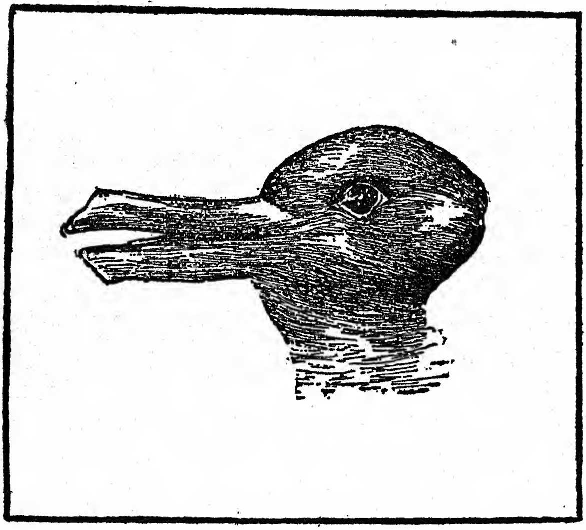


FIG. 31. DUCK-RABBIT FIGURE

After *Fliegende Blätter,* from Joseph Jastrow, *Fact and Fable in Psychology* (Houghton Mifflin Co., 1900).

Let us recall two or three instances of the dependence of a performance upon the conditions under which the appropriate resources of the organism are brought into commission. Suppose that you are suddenly confronted with the duck-rabbit picture. Whether you see the duck or the rabbit will usually depend upon the way in which you are disposed. If you had been shooting game-birds just before you sat down to read, the chances are that the duck would have first appeared. On the other hand, anything which disposes you

toward the perception of a rabbit would have turned you the other way. The shoplifter and the purchaser come to the store differently disposed toward action. The school pupil adds or subtracts the digits set down upon the blackboard according as he has been instructed, as he has previously been doing, or as the arrangement suggests. So with comprehension. "Spring" may go into the "season" topic or into mechanics or athletics, according as the conditions of understanding instruct. Again, our whole treatment of thinking was built upon the efficacy of the "problem" in arriving at a solution. And, in general, we are so constructed that what actually happens, in a given exercise of function, depends not only upon the fact that the organism has these four kinds of resource but also upon the circumstances under which the resources are brought into use. Many performances which are taken to stand for different functions are really carried through by one and the same function with different initiations. The problem, the set, and the disposition determine what shall happen, as much as the functional capability itself.[1]

For a long time psychologists were inclined to look upon "mind" as a kind of hopper into which materials were poured by feeding in "stimuli"; that is to say, by providing that the body should be carefully restricted to certain influences from without. Many behaviorists still take this older view, attempting to make a one-to-one correlation between "stimulus" and "response"; and the rough and uncritical procedure of the "mental test" overlooks the fact that the means, as well as the amount, of accomplishment depends upon the exact way in which the organism approaches a given task. But the descriptive psychologist has learned his lesson. He is just as careful to control disposition and task as he is to standardize the immediate experimental situation. We may

[1] It will be well to bear this fact in mind when we come presently to deal with the hundreds of "mental tests" which have been proposed.

profit, therefore, by his discovery that the organism is not an idle machine which can be set into operation by pulling a lever; but that it always tends some-whither and always performs as it is functionally inclined.

Ways of Initiating the Functions

With respect to the state of the organism when an operation begins, we distinguish (1) the neutral state, (2) the predisposition, and (3) the specified task. The technical use of these terms requires explanation. An instance of the first would be the sudden hearing of words in an Oriental tongue by a person limited to English speech. The sounds are heard; but there are no means at hand for using them. A familiar example of the second is the catching of familiar words where the hearer has been oblivious to the conversation. The sportsman catches the words "open season" where the actor would get fragments about "make-up," "stage," and "box office." We are all and always tuned for *some* functional performance; although the tuning often passes unrecognized for the want of an occasion to touch it off. The "task" or "problem," finally, we are familiar with from our study of action and thinking. As we shall continue to use the word, it implies a *formulated meaning*. The organism under a task comes to a performance with an anticipation, more or less explicit, that something is to be done. We exclude, then, from the task all automatized performances, as well as purely bodily sets and dispositions.

Since the living organism is never inert, never wholly indifferent to function, our "neutral states" can only refer to the fact that a given demand takes the individual unawares. Under stress of emotion elaboration fails, the "cool hour" being necessary for "reflection"; during thought, the perceptive functions are weak, and memorial recall often succeeds only when a special preparation vouchsafes certain aids to recollection.

Predisposition, our second kind of preparation, covers a wide variety of states and functional tendencies. Other terms used for its various forms are "tuning" and "*Einstellung*," the latter a useful word, sometimes translated "set." "Tuning" denotes a general readiness, such as comes from long study or employment or from devotion to an art. The chemist is tuned to whatever concerns his science and the director of athletics is likely to be alert whenever the sports are mentioned. *Einstellung* has been used to cover both a specific readiness due to monotonous repetition, as the necessity of the weary traveler to rhythmize after listening for hours to the clip-clap of the train, and also, more generally, to cover an established tendency to renew neural functions within the brain.[2]

Finally, "task" and "Aufgabe" we shall continue to use where an anticipative intent is present. It always involves a meaning which charges the organism with a future accomplishment. It is therefore more than a mere tendency toward function. The word "task" implies—as it does also in our everyday speech—that the organism formulates an obligation, or, at the least, an intent. When the formulation lapses, as it regularly does under repetition, there commonly remains the set or predisposition. The word *Aufgabe* has appeared in several psychological contexts. In its technical use, it has been chiefly derived from the experiments upon action. As early as 1893, Külpe[3] emphasized the importance for the

[2] *See* H. Ebbinghaus, *Grundzüge der Psychologie* (1911), 3rd ed., Vol. I, pp. 730-734; G. E. Müller and F. Schumann, *Archiv für die gesamte Physiologie* (1889), Vol. XLV, pp. 37*ff.*; E. B. Titchener, *Thought Processes*, pp. 134, 162, 173; and J. v. Kries, *Zeitschrift für Psychologie* (1895), Vol. VIII, pp. 1*ff.*

[3] It is confusing that the same word should have been used for the experimenter's problem and for the subject's means of initiating the "thought processes." *Cf. Titchener, op. cit.*, pp. 120-136, 161-164, 175 *note*. The term "task" is intimately related in history to Ach's "purpose" (*Absicht*) and to G. E. Müller's "telic idea" (*Richtungsvorstellung, Zielvorstellung*). *See* Müller's *Zur Analyse*, (1913), Vol. III, pp. 404, 446.

impulsive actions of attentive preparation; and, when Watt took up the analytical investigation of thinking by the method of "reaction," he set his observers the task of responding with a word for a part of the object named with a coördinate term, etc. The observers had, in all, six different tasks of this kind. These experimental requirements brought into existence, as Watt came to believe, the essential antecedent of thinking; namely, the "task" in the technical meaning. Thus from an "objective" task, in the sense of an arrangement for the experiment, he passes to the "subjective" task, in the sense of a psychosomatic preparation. It is only the latter which interests us here. Watt noted wide differences in clearness and explicitness of the formulated *Aufgabe;* while Messer (who—as we know—followed him) extends the term to include such purely neural predispositions as a permanent set to perceive all objects as "real." Of late the words "task," "problem," and "Aufgabe" have come to be used freely for almost any sort of determination or tendency; but it seems to be wiser, because clearer, to restrict them as we have suggested to formulated intents, and to leave the word "predisposition" for other forms of preparation. A careful use of these terms relieves us of a good many of the vagaries and the obscurities of the psychology of "will" and "purpose."

So far as we know, man is the only animal who formulates, whose psychosomatic functions may be introduced by a prophetic anticipation of a performance as something to be responsibly carried through. He is said to be "instructed," where another animal would perform under tuition or training. His instruction may come (a) from another person, as from the experimenter in the laboratory or the overseer or foreman in industry (formal instruction), (b) from the occasion—*e.g.*, "here are words to be translated," "the cause of this curious event must be thought out" (occasional instruction), or (c) from the individual himself. In the last

case, the individual is said to be "self-instructed"; for here the organism itself both determines in advance the functional mode and formulates the preparation. The psychologist has discovered that these self-instructions are often insidious in their influence upon experimental performance.[4] Frequently the observer does not realize that he has been set in a particular way for carrying through a performance. Thus a person under optical examination is asked to name colored wools. He calls certain oranges "reds" because they seem to go with the "brickish" colors and other oranges "yellow" because they suggest pale vegetation. Unless he is trained in observation, he will be quite innocent of the instruction which guides him in his perceptions. When we come to the psychophysical metric methods we shall see that any precise measure of function has to take very carefully into account all these subtle influences of instruction upon the mode of performance.

A common vehicle of instruction, of whatever variety, is language. We recognize this fact most clearly in "willed" actions, because there the self-determinations have important ethical bearings. The moralist gives the admonition; "say 'I *will*' or say '*no*' and thus fortify your resolve." But this is only a special case of a general dependence of function upon that explicit form of preparation known as the "instructed task." Language is a great convenience; but by no means—as we saw in the chapter on thinking—do we always depend upon it for formulating our intents.

---

[4] The instructions appear to the observer in many guises; *formal instruction* as a statement, request, command, caution, explanation, query, or hint; *self-instruction* as an admonition, doubt, query, comment, self-censure, command, or approval; while in the *occasional* form as many clews to the appropriate performance are offered as there are types of occasion. In addition, all three kinds of instruction may take the negative form: "Do not," "I must not," "That does not call for," etc.

Functional Preparation Reviewed by Modes

Let us briefly review, with the three grades of preparation in hand (neutral states, predisposition, and task), our four fundamental modes of psychosomatic function.

The common *perception* of our surroundings may find us relatively neutral. At times we take objects pretty much as they come. But usually we perceive with a bias. We observe the woods and the hedgerows, or the crops, or the contours of the land. This bias means that we are neutral with respect to many things. The extent of our neutrality depends, of course, upon training and wont. Very likely there are ultimate individual differences, too. Still the organism is limited, looking upon the world piecemeal; so it is necessary that many appeals through the receptors must be disregarded or at the least postponed. This reverse side of perceptual bias is apparent in the absent-minded individual, who is intent in his own field but unperceptive outside. The contrast between a fixed *Einstellung* and that form of perception which is constantly coached and encouraged is presented by the trained zoölogist and the young novice in the same subject who adequately perceives the materials in his dissection-pan only so long as he refers to his printed instructions. Training in perception tends also to add the comprehensive functions, which seem always to be present in scientific and in expert observation. Here the object is not only apprehended; it is also brought under the topic. The progress from perception to understanding or comprehension is to be noted likewise in those abstractive and partial inspections which give us our attributive knowledge of things. We say that we "perceive" form and color and the composition of groups and that we "perceive" differences of height and of length; but usually topical disposition is added to mere apprehension. When it is not, perception succeeds by an "abstracting task" or by the fixed and unformulated

predisposition which legitimately follows the habituated trend.

As for *memory* the apprehension of objects and events as from a personal past, the loose recovery of a series of connected events, comes nearest to a neutral state; but even here a central bias, in the form of reproductive tendencies, is necessary to introduce and to preserve the retrospective function. What we call "active recollection" is memory under instruction (as if one said "I must recall what I did after yesterday's breakfast"); and the verbigerative recall of age is due to a persistent set which constantly favors the memorial form to the detriment of other functions.

A frequent confusion of the perceptive and the memorial functions under specific *Aufgabe* appears in what is known as "intentional learning." Two cases must here be distinguished. In the one, objects, words, or nonsense syllables are apprehended, with the instruction to "learn" or to "retain." The instruction takes various forms. It may be imposed, as in the "learning experiment," or it may be self-given. The future use of our experiences is so important that we have devised a large number of learning tasks. Put into words, they run "I must recognize this object when I see it again," "I must permanently retain this man's name," "I shall observe this clearly and responsibly," "I must remember that *this* goes with *this*," "This order must be kept for the reproduction series," etc. We loosely call these performances "learning," as if we were employing some special powers of mind when, as a matter of fact, we are perceiving (or perceiving and comprehending) under special *Aufgabe*. In the other case [5] (also included under "learning") a special task is formulated at the time of revival, *i.e.*, at the subsequent time when earlier experiences are to be used. Here the *Aufgabe* is that of "recall." The instruction is given

[5] G. E. Müller, *Zur Analyse* (1913), Vol. III, pp. 292*ff*.

(either from without or by the individual to himself) in an appropriate way; and the task is set of recollecting "which syllable went with *zom*," "the line which followed so-and-so," "the name of the table partner at Smith's dinner," and the like. Here again, as we have argued, no unique "acquisitive" or "learning" function is brought into commission.

In *imagination*, likewise, free phantasy suggests a neutral approach to ideal construction; though, like memory, this form of apprehension always rests upon the bringing into train of reproductive tendencies: poetic creation and also—if we can believe the confessions of the novelist—much of the writing of fiction rests upon a general predisposition or tuning; while the "scientific use" of the imagination in the proposal of hypotheses and the establishment of principles depends upon the formulation of specific problems or tasks.

Our discussion of *action* has sufficiently recognized the part played by *Aufgabe*, as well as the tendency of the latter to dissolve, under repetition, into the various grades of predisposition which mark the automatized forms of execution. Here we see again that many unlike accomplishments of the organism may be mediated by one and the same type of function when initiated from a wide variety of sources. The intent to do one thing rather than another may lead to a highly specialized performance, although the executive mode is of the common sort. The ability of the human organism to carry through long and consistent actional trains (such as the ligated chain-movements of walking, of sport, and of musical performance) is due to the constant shifting of *Einstellung* as the action progresses, each phase preparing for the next. Here, we often find, too, the curious effect of one common "master-task" supervising the entire train of half-automatized details. Thus the comment "I shall make my way through the forest," "I must do my best during this set of tennis," or "I am responsible for an intelligent interpreta-

predisposition which legitimately follows the habituated trend.

As for *memory* the apprehension of objects and events as from a personal past, the loose recovery of a series of connected events, comes nearest to a neutral state; but even here a central bias, in the form of reproductive tendencies, is necessary to introduce and to preserve the retrospective function. What we call "active recollection" is memory under instruction (as if one said "I must recall what I did after yesterday's breakfast"); and the verbigerative recall of age is due to a persistent set which constantly favors the memorial form to the detriment of other functions.

A frequent confusion of the perceptive and the memorial functions under specific *Aufgabe* appears in what is known as "intentional learning." Two cases must here be distinguished. In the one, objects, words, or nonsense syllables are apprehended, with the instruction to "learn" or to "retain." The instruction takes various forms. It may be imposed, as in the "learning experiment," or it may be self-given. The future use of our experiences is so important that we have devised a large number of learning tasks. Put into words, they run "I must recognize this object when I see it again," "I must permanently retain this man's name," "I shall observe this clearly and responsibly," "I must remember that *this* goes with *this*," "This order must be kept for the reproduction series," etc. We loosely call these performances "learning," as if we were employing some special powers of mind when, as a matter of fact, we are perceiving (or perceiving and comprehending) under special *Aufgabe*. In the other case [5] (also included under "learning") a special task is formulated at the time of revival, *i.e.*, at the subsequent time when earlier experiences are to be used. Here the *Aufgabe* is that of "recall." The instruction is given

[5] G. E. Müller, *Zur Analyse* (1913), Vol. III, pp. 292*ff*.

(either from without or by the individual to himself) in an appropriate way; and the task is set of recollecting "which syllable went with *zom*," "the line which followed so-and-so," "the name of the table partner at Smith's dinner," and the like. Here again, as we have argued, no unique "acquisitive" or "learning" function is brought into commission.

In *imagination*, likewise, free phantasy suggests a neutral approach to ideal construction; though, like memory, this form of apprehension always rests upon the bringing into train of reproductive tendencies: poetic creation and also—if we can believe the confessions of the novelist—much of the writing of fiction rests upon a general predisposition or tuning; while the "scientific use" of the imagination in the proposal of hypotheses and the establishment of principles depends upon the formulation of specific problems or tasks.

Our discussion of *action* has sufficiently recognized the part played by *Aufgabe*, as well as the tendency of the latter to dissolve, under repetition, into the various grades of predisposition which mark the automatized forms of execution. Here we see again that many unlike accomplishments of the organism may be mediated by one and the same type of function when initiated from a wide variety of sources. The intent to do one thing rather than another may lead to a highly specialized performance, although the executive mode is of the common sort. The ability of the human organism to carry through long and consistent actional trains (such as the ligated chain-movements of walking, of sport, and of musical performance) is due to the constant shifting of *Einstellung* as the action progresses, each phase preparing for the next. Here, we often find, too, the curious effect of one common "master-task" supervising the entire train of half-automatized details. Thus the comment "I shall make my way through the forest," "I must do my best during this set of tennis," or "I am responsible for an intelligent interpreta-

tion of this composer," combines simplicity of task with multiplicity of unformulated "sets," and thus serves to carry through a complicated series of actions.

It is important to note that in action we have the task entering as an integral part of the executive function itself, which consists in a working through to a solution, by use of all the bodily and mental resources at command.

The close functional relation of action to *emotion* would lead us to expect a similar implication of problem and predisposition. Prominent in the emotion we found the predicament, which is, as it appears, essentially an insoluble problem. The organism is seized; and seizure means preparation. In some cases the preparation may be in part hereditary; but usually it derives from individual experiences. Fear of the innocent mouse, distress before suffering, and resentment at a slight, all imply organic priming. That need not imply that the organism is, at the moment preceding the emotional occasion, especially inclined toward one kind of seizure or another. In that sense the organism may be in a neutral state; but with many emotive possibilities. The occasion presses the proper key, so to say, and immediately the predicament impends. In those cases where the preliminary inclination is at hand (as in the "fearful" person abroad at night, or the "sensitive" person keen upon being insulted), the resulting emotion is more nearly inevitable and more profound. In the emotive episodes and trains, the general affective tuning of the *mood* frequently plays an important rôle in consolidating all the successive phases into a single emotion. The hour spent with the dentist, the lover, or the bore may, thanks to a sustaining mood, count as such an integral emotion presenting a hundred phases or facets.

The key to *comprehension* is—to repeat—the topic. When we "think about" botany, history, or atomic structure, we use our comprehending functions to consider objects or facts in relation to an organized topic, within a prescribed context.

The typical predisposition involved is the topical association. That is to say, comprehension feeds upon constellated neural tendencies within the central nervous system; for these latter are designed, in terms of our vague theories of cerebral mechanics, to supply the relevant materials for a given topic. We all know the discomfort of making our way into a new subject of study or into a different game. The topic has not yet germinated. Comprehension halts because it wants its appropriate predisposition.

Topics may also be sustained and enriched by the task or *Aufgabe*. The wise teacher or the serious student takes pains to formulate helpful instructions: "Where should one *expect* the history of the French Revolution to begin?" *"What sort* of circulatory system may I reasonably look for in this earthworm?" "Can I use my French as an aid in reading the *Canterbury Tales?"* and the like. Much of the search for information under the task which is commonly ascribed to thinking is really this sort of topical comprehension. And most of the variety of what many psychologists call the "cognitive functions" is actually a variety of task and instruction and not a variety of function at all. And we animadvert again, in this connection, upon that anomalous category named "learning," which involves comprehension as well as action and perception, but which points rather to a group of tasks and a medley of predispositions than to any unique function of the psychosome or to any "capacity" or "faculty" of the "mind."

As for *thinking*, our prodigiously long treatment of that grisly subject leaves little to be said. Complete thinking always implies and includes the problem or task. No one is ever innately predisposed to think, and no one ever thinks out of a neutral state. Only the specific positing of a particular task leads on to genuine elaboration by the way of symbols. On the other hand, our study has revealed both the wide variety of thought-problems and the many resources

of the organism which are requisitioned for the elaborative solutions.

In fine, the examination of those organic accomplishments which involve both mental and bodily factors has thrown into relief four great types or genera of function, the apprehensive, the executive, the comprehensive, and the elaborative. These functional modes are set into commission by occasions which either release the predisposition or formulate the task or *Aufgabe*. When the occasion supervenes upon a precedent neutral state, the function either fails to appear or awaits a more favorable setting. The enormous number of different ends attained by the versatile human organism is rather to be attributed to the variety of predispositions and tasks than to the array of hypothetical "mental powers" and "capacities" assumed by common sense and technological practice.

CHAPTER XVII

THE LIMIT OF PSYCHOSOMATIC FUNCTION

"Capacity" and the Limit of Function

Since perception, action, thinking, and the other psychosomatic functions are all modes of performance, ways-in-which the organism operates, it is appropriate to ask how far these functions can be carried, *e.g.,* how many simple objects an individual can perceive or remember in a given time, how delicately one can distinguish linear distances by the eye, how rapidly one can tap upon a key, withdraw the finger at a signal, solve thought-problems, and so on. That is all we shall mean by the extreme or upper limit of a given function or of a group of functions; the limit as actually attained and recorded in a given performance and under given conditions.

Since we are concerned here with "full measures," the word "capacity" suggests itself as a suitable term to designate the top limit of function. We speak of the capacity of a vessel as a quart or a gallon and the capacity of a power plant as so many thousand kilowatt-hours, meaning that when the vessel is filled to its limit or the plant is delivering its total power such-and-such an amount results. But "capacity" also conveys the meaning of a *potential* measure; it indicates the possibility of a fixed limit when the limit is not actually attained. Thus we remark of a university student that he has a "large capacity" for accomplishment, although he never exerts himself; implying that he has latent powers which diligence and persistence would utilize. At times this potentiality is made specific, as when a child is said to give evi-

dence of a capacity for music or drawing or mechanics. Used in this sense, capacity is practically the same as an unused "talent" which may be employed or kept in reserve. Again, the term is frequently made to designate an assumed inherited resource. Thus Thorndike[1] adds capacities to reflexes and instincts, as general racial endowments; as endowments which constitute a part of the "original nature of man." All of these common uses of the word "capacity" render it unsuitable for our own present purposes. When applied to functional measures of the organism, they suggest too strongly the existence of faculties or gifts of nature which have a real but hidden existence. Once we gave the assumed cause or condition of a functional performance the name "capacity," we should presently come to think of it as a real force and clothe it with convenient attributes. This is the insidious error of the "faculty," which has done great injury to the physical and biological sciences, as well as to psychology.[2]

Now it is obvious to all of us that our functional performances are limited. While we can drive ourselves to accomplish a given task in a given time, a more complicated task either lies beyond us or at the least requires an extension of time or a more favorable occasion for its performance. Our studies fill our day, business exhausts our energies, professional demands tax us to our limit. The resources of the organism are definitely limited; although we may have to admit that we do not often come to the extreme term of accomplishment.

Just as obvious as this fact of limit, however, is its variability. One day the limit is high, another day low. An insoluble task yields to practice or melts away after a good

---

[1] E. L. Thorndike, *Educational Psychology* (1913), Vol. I, p. 5.

[2] The term "capacity," when used in its common definition, *potentia recipiendi aliquid*, is closely allied, in the history of thought, to the concept of "energy," the capacity for doing work. *Cf.* R. Eisler, *Wörterbuch der philosophischen Begriffe* (1904).

night's sleep, or it may only need a greater urge or a stronger resolve or a new method of solution.[3] So versatile is man and so complex are the conditions of his performance that it requires pains and refined methods to find anywhere in human accomplishment such fixed "constants" as the breaking point of a standardized steel or the melting point of a chemically pure substance.

In spite of this common observation that the limit of function advances and retreats from day to day and from condition to condition, we constantly assume not only that there are limits of performance but also that the limits vary in an assignable way from individual to individual and from occasion to occasion.

A great many of the epithets by means of which we seek to characterize our fellows prove upon scrutiny to indicate notable differences of accomplishment. For social and human purposes we tend to exaggerate these differences making them appear as qualitative peculiarities. Thus we say of our neighbors or of our children that *A* is industrious and *B* lazy, that *C* is bright and *D* is dull, *E* irascible and *F* of an equable disposition. All the time we know, however, that human beings are modeled after the same pattern, all possessed of the same ultimate qualities and all capable to some

[3] In an essay upon "The Energies of Men," William James declared that "the human individual lives usually far within his limits. . . . He energizes below his maximum and he behaves below his optimum. . . . Of course there are limits: the trees don't grow into the sky. But the plain fact remains that men the world over possess amounts of resource which only very exceptional individuals push to their extremes of use. . . . We ought somehow to get a topographic survey made of the limits of human power in every conceivable direction, something like an ophthalmologist's chart of the limits of the human field of vision." (*Philosophical Review*, 1907, Vol. XVI, pp. 1*ff*.) The initiated reader of James will not miss the ethical implication that man possesses a "capacity" in the sense of ultimate "reach" toward which his "grasp" should strain. This is, of course, not our factual limit of performance under prescribed conditions of practice, age, education, instruction, etc.

extent of the same fundamental functions. The final differences are presumably differences of degree. At least so far as we can describe human beings in quantitative and numerical terms, we may reasonably hope to be able to place them upon the same scales and to measure them by common means. Whether any such quantitative delineation is at present feasible or, if feasible, then adequate to the differences of men, we shall have to ask when we have surveyed the relevant factors and the available procedures.

For the present let us confine our attention to the question of functional limit and to the methods which have been proposed for its determination.

The Measurement of Function

The phrase "limit of function" suggests measurement. It suggests varying amounts of functional performance which might conceivably be laid off along a graduated scale with "zero" written at one end and "capacity" written at the other. Immediately we think of our spatial scales and rulers divided up into inches or millimeters. These linear units, laid along or superposed upon unknown extents, give us our simpler and more familiar examples of measurement. There the process consists in finding how many times the unit is contained in the total extent. The procedure implies that the extent to be measured can be divided up into (or, at the least, considered as made up of) a number or "multitude" of homogeneous and equal parts. Superficial and solid measures and measures of liquid contents (*e.g.*, the liter or gallon), as well as such weighing measures as are determined by balances and scales, are essentially of the same order. At times it is impossible or impracticable directly to take a unit-quantity of the thing to be measured and to lay it along the whole "extent." Then it is common to use a substitutive unit. Thus we measure time in spatial units (clock hand or stellar position) or in changes of light (day and night)

or in alterations of temperature and of season (summer, autumn, the year). Although we then *report the result* in time-units (second, minute, year, century), we actually *estimate* by means of the spatial, photic or thermal substitute.

Another circumstance which complicates the art of measurement is that the "magnitude" which we propose to measure does not always imply divisibility. When a dozen toy balloons suddenly released float away into the heavens it presently becomes obvious to the onlooker that some of the receding objects "look small," having been swiftly carried away by air currents, and others "look large." Some are correspondingly "far away" and others are "near at hand." Neither of these estimates of "magnitude" (size and distance) waits upon the reflection that one balloon appears to hold 75 cubic inches (or to be 4 inches in diameter), another 200, and another 450; or that one is 50 yards away, another 80, and still another 300. In other cases a difference of "magnitude" may with assurance be predicated when no division into parts is at all possible. My satisfaction at the election to office of "my" candidate is greater than at the discovery in my pocket of the exact street-car fare. The mother's anxiety over the lost child exceeds her anxiety lest the bread burn. The smart of heat upon the fireman's face exceeds the smart when a match approaches the cheek. One is more "hurt" at a friend's justified reproach than at a challenge from the traffic officer. It thus appears that spatial "magnitudes" can, at least in theory, be divided and scaled by units; but that other forms of magnitude may not—even in theory—be subject to division.

Is there, now, anything *mental* that is amenable to measurement? Are there mental "magnitudes," either divisible or indivisible, which the psychologist can be said to measure by direct means or by surrogate? There would seem, when we regard our whole treatment thus far advanced, to be three possibilities; namely, that the processes of experience,

the mental objects, should possess mensurable attributes; secondly, that the integrations or complex-formations should be measurable; and, thirdly, that it should be possible to measure the psychosomatic functions. An example of the first sort of measurement would be the measurement of the intensity or the quality of a "sensation"; of the second sort, the degree of fusion or other type of incorporation, as of two tones or two odors; and of the third sort, the determination of the least time (let us say) in which 5 or 20 like geometrical objects should be perceived or named or recollected.

The Methods of Measurement

Before we go on to discuss these three possibilities of "mental measurement," we must observe that two large groups of method have been proposed for the quantitative study of "mind." One group contains the *psychophysical metric methods* (to be referred to as the *P*-methods) and the other the *methods of test* (the *T*-methods). The two groups have—as we shall presently see—the same mathematical basis; and it would be more logical as well as more convenient if we could treat them together. They have had different histories, however, coming into psychology from different directions and with different contexts; so it is necessary to regard them, at least for the sake of exposition, as different kinds of procedure. We may hope, however, that whatever is of use to psychology itself—not to anthropology, to education, or to medicine—will presently be collected from the *P*-methods and the *T*-methods and consolidated under one single form of procedure.

The *P*-methods were named from the fact that they undertook to express a simple uniformity between mind and those physical agents (stimuli) which are directly related to experience through the avenues of the sense organs. Hence the term "psychophysical." The *T*-methods, on the other

hand, were proposed to "try" or to "test" the extreme capabilities of the mind, as the engineer tests the limits of performance of a machine or the endurance of a structure (such as a bridge) or of a single material (as steel or brass) under stress. They imply that the mind can be put to work and then measured in terms of its accomplishment or output. The *P*-methods came from a separate study called "psychophysics," while the other methods came in part from that branch of the quantitative study of mankind known as "anthropometry" and in part from "biometrics" (a fairly recent department of general biology and genetics). Testing has been encouraged by education and by other technological subjects which are interested in human abilities and human resources on the side of output and "efficiency."

So far as the general assumptions of these two types of method are concerned, they have much in common. They are both statistical; that is to say, they assume large numbers of homogeneous, or at least similar, phenomena, which can be grouped together and treated in the mass. They assume that the individuals in a given mass are regularly distributed, in respect to a given characteristic or "trait," and that the type of distribution can be quantitatively expressed or "measured." These statistical methods are widely used in the study of population, of birth and death rates, in financial problems, and elsewhere. They consider the individual phenomenon or person only as a member or a representative of, or a unit in, a large group.

For psychophysics the "mass" is a very large number of "judgments" or "reports" given by a highly trained individual under carefully controlled conditions. These reports vary among themselves from moment to moment and from day to day. They are said to be subject to "accidental errors." The statistical treatment of them is designed to discover and to state in a quantitative way the form and the extent of their distribution under the influence of these "errors." On the

other hand, the *T*-methods set a given task to many individuals and they make a similar assumption about the distribution of the performances. When a thousand persons perform the same task (*e.g.*, carry through a number of simple multiplications), the *T*-methods assume that the time occupied or the mistakes made will be distributed in a way which can likewise be statistically described. Each result is supposed to be subject to "errors," taken in the same sense. The statistical description, then, in this case, applies to the whole group of individuals; just as it might give the plan of distribution of statures in an army of men, without saying anything about any single individual soldier.

The two sets of method suggest the distinction between microscopic anatomy and gross anatomy. The *P*-methods are at great pains, using the most refined tools of experiment, to discover and to quantify some simple and fairly constant function of the individual person; while the *T*-methods start with a gross, unknown, and undefined performance of the individual. Instead of assuming, as the *P*-methods assume, that this "sample" is subject to large variations, the *T*-methods accept it straightway as representative of the individual and throw it into a mass of samples similarly secured from many other individuals.[4] The statistical refinement of the *P*-methods begins, therefore, where the statistical refinement of the *T*-methods leaves off. In spite of the like statistical foundation of the two types, the degree of refinement, then, as well as the unlike history and context, which we noticed before, compels us to give them separate expositions.

---

[4] Thus the individual "variate" (the test-result from a single person) is only a sample of all the varying performances of that individual. The *T*-methods may be said, therefore, to involve accidental errors of two orders. It is a question, however, whether the gross procedures of testing do not introduce errors which are larger than the total range of variability of individual performance. They are certainly much larger than the *P*-methods could tolerate.

The Psychophysical Metric Methods

The methods of psychophysics were alleged by Fechner, the founder of that branch of science, to measure sensation—to measure and also to set it into exact relation to measurable quantities in the physical world. Fechner maintained that sensations could be indirectly or substitutively measured.[5] Taking Weber's observation that the intensive increase of pressure ran parallel to the intensive increase of weights laid upon the skin, so that, *e.g.*, the increase of 10 drams to 22 drams gave the same intensive increment (for "sensation") as the increase of 10 half-ounces to 22 half-ounces, or of 10 ounces to 22 ounces,[6] Fechner generalized this relation obtaining between sensation and stimulus and called the generalization Weber's Law.

Now the fact of the dependence of sensible intensity upon the relative difference of two stimuli is indubitable. It has been verified by many observers for the middle range of in-

---

[5] G. T. Fechner (1801-1887), *Elemente der Psychophysik*, 2 vols. (1860).

[6] It will be observed that, under these increases, the stimulus-ratio is the same, *i.e.*, $\frac{22}{32}$, whether the absolute masses are drams, half ounces, or ounces. The results are the same, also, when the ratios are all expressed in a single denomination, *e.g.*,

$$\frac{10 \text{ oz.}}{15 \text{ oz.}}, \quad \frac{20 \text{ oz.}}{30 \text{ oz.}} \quad \text{and} \quad \frac{50 \text{ oz.}}{75 \text{ oz.}}$$

In this instance the stimulus-increment is always one half of the weaker weight. E. H. Weber (1795-1873), physiologist at the University of Leipzig, stated his results in 1834 as follows: "In comparing objects and observing the distinction between them, we perceive, not the difference between the objects, but the ratio of this difference to the magnitude of the objects compared." So far as the "law" holds, it means that to acquire a given intensive increase it is always necessary to add a constant fraction of the stimulus: 1/3, 1/5, 1/40, 1/100, etc., according to the modality or the sense-series (brightness, noise, tone, etc.). For a brief discussion of the facts, *see* W. B. Pillsbury, *Fundamentals of Psychology* (1922), 2nd ed., pp. 194-198.

tensities (not for the weakest and the strongest), in brightness, noise, tone, pressure, strain, and smell. But Fechner made the mistake of assuming that a given intensity was made up of a number or "multitude" of little "unit" intensities, as the hour is resolvable into seconds and the mile into feet. Thus he thought that he could regard sensation as a mathematical function of the physical energy released by the stimulating agent.[7] But sensational intensity is not a "multitude." It does not run up by degrees from zero. It is just itself. It is not divisible. Hence it cannot be laid along a scale of intensities and "measured" in terms of a unit-intensity. An enormously complicated discussion upon the matter of measurement in psychology arose after Fechner's exposition.[8] G. E. Müller and others objected to Fechner's measurement of the sensation. It was maintained, however, that *sense distance,* based upon the observed *differentness* or disparity of the sensations could be measured.[9] It was pointed out that two slightly different sensations, *a* and *b,* were directly apprehended as of a certain unlikeness and that this degree of unlikeness could be represented by a definite sense-distance, *a—b,* which might be duplicated over and over with other sensations, as *c—d* and *l—m.* Since this sense-distance can be equated to other like sense-distances, in other parts of the intensive scale, it may, so the new argument ran, be regarded as a unit and other sense-distances actually *measured* as multiples of it. To make the matter of measurement more plausible, it was argued that "distance,"

---

[7] The function, as Fechner derived it, was logarithmic; sensational intensity was said to be proportional to the logarithm of the stimulus.

[8] For historical surveys of the discussion consult E. B. Titchener, *Experimental Psychology* (1905), Vol. II (*Quant.*), Pt. II, pp. xiii*ff.*; E. G. Boring, *American Journal of Psychology* (1921), Vol. XXXII, pp. 440*ff.*; Warner Brown, "The Judgment of Difference," etc., (1910), *University of California Publications in Psychology,* Vol I, No. 1, pp. 1-71.

[9] The positive suggestion came from J. R. L. Delboeuf (1831-1896), *Revue philosophique* (1878), Vol. V, pp. 53*ff.*

taken in the same sense, is always implied in any unit of measurement. In the linear scale the inch unit is just the differentness of two positions (the ends of the inch) regarded as establishing a "stretch" or "distance," which may be taken over and over in the process of measuring. The unit first settled upon was the just noticeable or the smallest noticeable difference (*j.n.d*), whether of intensity (strong or weak), quality (color-hue, tonal pitch), extent (tactual or kinæsthetic distance), or duration. "Just-noticeability" is not, however—as it seems to be—a matter of direct observation but of inference. No sense distance wears upon its face a "just noticeableness." It is now common to replace it by the *liminal* or threshold difference (*DL*), a calculated value standing midway between difference and no-difference (equality or uncertainty), and derived by the mathematical laws of "probability."

After a long and extremely acute discussion, in which the concept of measurement, as developed in mathematics and in the physical sciences, was carefully analyzed, psychologists generally accepted the notion of the sense-distance and rejected Fechner's contention that the sensation was a divisible or at least a measurable magnitude. A given disparity or unlikeness of intensity, for example, was taken as the unit and compared with other "distances" which were found to be either like it or different from it. Thus the *comparison* of sense-distances was set up and made the basis of measurement. It is always possible, at least in principle, to say that two sense-distances are either alike or different. But it is no more possible to superpose or to place end-to-end sense distances than to piece together little (weak) sensations and to make one big strong intensity. Several attempts were made to prove that a given number of unit-distances (*e.g.*, the threshold or liminal distance) always gave the same total distance; but the success of the attempt has not been universally acknowledged. Were it true, then two

large equal sense-distances (say the distance black-to-middle-gray and middle-gray-to-white) should be found to contain the same number of units of liminal or of just-noticeable distance. The interpretation of the results of various methods is not wholly unequivocal. So we cannot be sure that all just-noticeable distances or differences are equal. Even though they were equal, it does not seem to follow that 5 or 15 or 25 of them would always make the same supraliminal distance.[10] We certainly do not superimpose these distances upon each other in the sense that a given sense-distance contains a number of smaller or unit distances. The distance is no more a "multitude" than the sensation is.

Are Mental "Processes" Measurable?

The entire difficulty rests, as the present writer believes, upon the erroneous contention that mental "processes" or mental "objects" are themselves the magnitudes measured in the *P*-methods. What is measured there is the functional limit. In any observation of "sense distance" the report is reducible to "presence" (or "non-presence") or to "difference" (or "non-difference"). A weak stimulus (say, sound or light) is presented and the observer reports that the appropriate sensory quality is present (or is not-present); two similar stimuli (say, two moderate sounds from falling steel balls) are given in succession and the observer reports an intensive difference (or its want); two unlike pairs of stimuli (say, two moderately weak sounds and two moderately strong sounds) are given and the observer reports the intensive

---

[10] One grave objection to the demonstration lies in the fact that it is extremely difficult for the observer to maintain the same general attitude toward little distances and big distances. *See* S. S. George, *American Journal of Psychology* (1917), Vol. XXVIII, pp. 1*ff.*; E. G. Boring, *Psychological Review* (1920), Vol. XXVII, pp. 440*ff.* For a general review of the literature refer to E. B. Titchener, *Experimental Psychology* (1905), Vol. II (*Quant.*), Pt. II, pp. lxviii-lxxxix.

distances as different (or not-different). Always the abstractive apprehension of sheer presence or of difference. And this means, at bottom, observation under the task or *Aufgabe* of discrimination—the discrimination, *e.g.*, of sound from no-sound, of one sound from another, or of one sound-distance from another. Mental factors are always involved; but no more and no less than bodily processes. Both are involved in the coöperative sense of the psychosomatic function. As we discarded the alleged "mental functions" from our treatment of perception, action, thinking, and the rest, so now we discard the notion of "mental magnitudes" and of "mental measures" from the *P*-methods, which treat in a quantitative way the limits of these same functions.

This resort to "capacity" in the sense of "limit of function" does not involve us, as some adherents of mental measurement assume that it must, with the psychology of "stimulus and response."[11] We do not gratuitously interpret all performances of the organism under those biological terms. Neither does it involve an appeal to behaviorism or to meaning and *Kundgabe* as set against "processes" and *Beschreibung*, as Boring suggests (*loc. cit.*, 461). It has been common in psychophysics to confuse three distinct things; namely, the psychophysical observation, the fact observed, and measurement. We have already explained that the observation is not the measurement. Measurement is a means of treatment which is used after the observation has been made. As for the first two terms in the confusion, the observer apprehends abstractly under the psychologist's *task* of discrimination. The fact apprehended is, as we have said, either "presence" or "difference." It is the functional limit of this apprehension which is subsequently measured by the experimenter. It is an accident of nature, so to say, that the measure turns out to be a record of "capacity." If

[11] Titchener, *op. cit.* (1905), Vol. II (*Quant.*), Pt. II, p. cxxxiv; Boring, *American Journal of Psychology* (1921), Vol. XXXII, p. 460.

a functional mode could be accurately determined at "½-capacity" or at "¼-capacity" or at any other rate below the limit, there would be no objection in the world. It is a convenient convention that our functional measures—in physics as well as in psychology—should be "full up." The experimenter does, of course, in practice, slow down "capacity" by fatigue, difficulty, over-loading and what not; but that again is only to set a new capacity under new conditions. Five-miles-an-hour-up-grade may be as true a measure of capacity of a locomotive as fifty-miles-on-the-level.

It seems to follow from our conception of function that the charge of the "stimulus error" is not properly ascribed to our kind of measurement. It appears from various experimental researches that the functional limit is extremely susceptible to delicate variations of the mental and the bodily factors concerned in the psychophysical observation. If the technical *task* is to discriminate physical objects (the weights laid upon the skin or lifted in the hand, the steel balls falling upon the metal support), the report of the observer is extremely likely to be different from that under the *task* to apprehend the presence or the difference of a bare attribute (*e.g.*, intensity) considered in complete isolation from the object. Furthermore, it has been sufficiently demonstrated that a "judgment" passed upon physical objects is very likely to be equivocal and therefore irregularly shifting, because objects are ambiguous and many-sided and variously regarded. Thus, if I estimate the intensity of a falling steel ball in terms of the ball itself, I may be determined by (a) a visual image of the dropping ball, (b) a mixed visual-auditory image which means "there it strikes the support," (c) a somæsthetic perception of the stroke of the ball, (d) a verbal comment "It is striking hard" . . . "striking light," (e) a dynamic perception of the impact at the end of the fall, and so on and on. No one who has not actually observed in the psychophysical experiments will conceive the large number

of ways in which so simple a perception as that of a falling ball can be taken. Pratt[12] has recently given an impressive illustration of the diverse ways of apprehending the relation of two simultaneous tones and Boring[13] has done a similar service for the perception of place or of disparate localities upon the skin.

Now it is because the psychophysical report varies irregularly wherever it is dependent upon the ambiguities of perception that the "introspectionist" has laid emphasis upon the "stimulus error."[14] But his inference that the stimulus error introduces something which is not a true "mental measurement" is wrong. The important methodical point at issue is that any variable and uncontrolled factor (save the "constant" errors which can be calculated and the "accidental" errors which are inherent in the organism and are included in the final measures of central tendency and of distribution) is to be eliminated from the experimental setting. It is wholly

---

[12] C. C. Pratt, *American Journal of Psychology* (1921), Vol. XXXII, p. 490. Pratt showed that the bitonal relation might be based upon smoothness, simplicity, feeling, volume, rotundity, and other criteria of "fusion." Where *spatial* objects are perceived we may well expect still greater ambiguity.

[13] E. G. Boring, *ibid.* (1921), Vol. XXXII, pp. 465*ff*.

[14] "Object error" would be preferable, in psychophysics, to "stimulus error." Except in the gross use of the behaviorist, where the technical term "stimulus" has been misapplied to denote any object or occasion which demands of the organism a "response," the word "stimulus" is never synonymous with "object perceived"; *i.e.*, the end of the perceptual meaning instead of the physical agent (describable in physical terms) which excites a receptor. Neither is it "error" taken in the mathematical sense. If the chemist, in determining the atomic weight of nickel or iron, were carelessly to include traces of other substances, it would be regarded less as an "error" than a defect in procedure. Of course the "error" may refer to ambiguous *mental* factors as well as to characterizations of the "object." Thus Pratt includes roughness (a temporal-intensive pattern) and pleasantness-unpleasantness. Boring chose an unfortunate illustration of the "stimulus error" where he was obliged to call his perceptual patterns "mental processes" (467) and "process material" to distinguish them from "stimulus." The double-paddle, oval, dumb-bell, and the rest

impossible to measure a psychosomatic mode of functioning unless that is, first, determinable and, secondly, constant in character.

The possibility of applying the concept of measurement to mental integration we can dismiss with a few words. One of the great historical attempts to measure the interaction and the synthesis of "mental processes" was made by the philosopher J. F. Herbart (1776-1841). Herbart conceived the mind as a theater of dynamic and active ideas (*Vorstellungen*). Every idea was self-assertive. It sought to lift itself from the "unconscious" into conscious existence. But since the stage of mind was limited, permitting only a few ideas to appear at a given time, rival forces constantly contended for position. Herbart thought that the relative strength of these ideational forces could be measured and mathematically expressed. He wrote accordingly a mental "statics" and mental "dynamics." But the notion was not

---

are obviously spatial figures, no more mental than blackboard squares and triangles. To call them "phenomenological" does not make them mental; though it may otherwise define their existence in the world. His demand for the avoidance of the "stimulus error" is correct in principle; but the avoidance should not depend upon the identification of perceptual patterns with "mental processes" and it does not imply that "mental processes" are measured by the metric methods. In a futile criticism of the position which Boring defends, J. R. Kantor devotes thirty pages (*American Journal of Psychology,* 1922, Vol. XXXIII, p. 481) to an attempt at the "reconciliation" of introspectionists and "objectivists." He maintains (as the basis of reconciliation!) that "the interpretation of psychological data as anything other than responses to stimuli . . . is the outcome of peculiar philosophic preconceptions." How well Kantor comprehends the position which he combats may be inferred from his naïve question, "Unless the structuralist considers sensations to be phases of reactions would he not be inevitably and hopelessly committed to stimuli-errors?" (p. 496.) The faith of the "objectivist" in a one-to-one coupling of stimulus and response recalls the confidence with which psychologists of a generation ago assumed a like correlation between stimulus and sensation. That was before the days of *Aufgabe* and instruction!—In the article cited Boring gives a useful history of the term "stimulus error" (pp. 449-462).

sustained by facts.[15] What was valuable in it was preserved by Stumpf, Külpe, and others in the doctrine ot mental connections, which demanded rather a qualitative description than a mathematical treatment.

We reject, therefore, the proposals to measure "mind," whether we take the mental items individually or in integration; and we confine our discussion of measurement to the limit of those functions in which mental and bodily factors coöperatively unite in performance.

What Is Measured in Psychophysics?

The metric methods of psychophysics are based, as we have seen, upon observation. But the measurements which they devise are the product of mathematical processes. Measurement in this field involves more, therefore, than the laying down of the yard-stick or the reading off of a "mental" amount. In the case of the difference limen, we saw that no discriminable difference or "distance" appears as "just noticeable"; that the liminal difference is the product of computation; that it is that fixed difference of stimulus which eventually gives rise, under certain organic conditions and under certain instructions, to 50 per cent of "unlike" reports. We distinguish, then, between the observation and the "true" or "probable" measure of function, which comes from the calculated result of many observations. This principle of calculated measures applies likewise to the other procedures of the *P*-methods; and this is precisely what we find to be true of measurement in the physical sciences. The degree of expansion under rise of temperature or the time of transit of a star is derived from a large number of ob-

[15] Herbart's attempt is worth citing for its historical importance as well as for the frequent substitution, since Freud first outlined his speculative doctrine of the unconscious, of similar logical concepts for the factual description of mental organization. A current example is the building up of mind or of "experience" out of logically devised "instincts" and "habits."

servations, none of which, being subject to "errors" of various kinds, could be called a "measure." Even when the "constant errors," such as those due to the spatial and temporal setting of the experiment, are removed by calculation the single observation is still subject to "accidental errors" or "errors of observation"—errors which arise, as we have seen, from a constant interplay of variable conditions and which can be allowed for, by appropriate statistical means, but not removed.[16]

It is assumed that these accidental errors are due to a large number of elemental factors or causes which combine in every possible way according to hazard. The "law of error," which provides a means for estimating the probability of certain combinations of these elemental and unknown factors, declares that (1) the frequency of the error depends upon

---

[16] It is not allowable, of course, for the psychologist merely *to assume* from the high variability of the observations that the reports are distributed according to the formulas for "chance." The experimenter first discovers how his reports of "greater," "equal," and "less" actually run in a given case and then he looks around for some mathematical formula or process which will fit the uniformity discovered. Urban has emphasized this factual basis of the *P*-methods in his doctrine of the "psychometric functions." These functions are the mathematical expressions for the exact way in which a given form of report (say), "greater" or "less," changes in relative amount as a stimulus difference gradually increases or decreases. Thus a gradual increase of a difference of stimulus is followed by a gradual increase of the number of "greater" reports or "judgments." The one increase is a function of the other. Urban speaks of this fact as the "probability of a given judgment." The formula which he finds best to fit his facts (lifted weights) is the phi-function of gamma, written ϕ (γ). Gamma is a product of a given variate (δ), measured along the line of abscissas, into a value (h) representing accuracy or precision. The expression reads, $\gamma = h\,\delta$. *See* F. M. Urban, *Psychological Review* (1910), Vol. XVII, pp. 243*ff*.; for a simpler exposition of the psychometric functions, *see* E. G. Boring, *American Journal of Psychology* (1917), Vol. XXVIII, pp. 465*ff*.; (1920), Vol. XXXI, pp. 1*ff*. For a criticism of Urban's use of the hypothesis, *see* G. H. Thomson, *British Journal of Psychology* (1912), Vol. V, pp. 203*ff*.; *Biometrika* (1919), Vol. XII, pp. 216*ff*.

its magnitude, the smaller errors occurring more often than the larger, (2) all errors tend to fall within a continuously graded series, and (3) in a long series of observations the *plus* and the *minus* errors will tend to occur with the same frequency. These assumptions have been carried over to the measurement of the limit of the root-functions which we are now considering; and the facts bear out the assumption that the simple observation of "presence" or of "difference" is commonly made under the play of factors akin to these inherent "errors of observation" in the physical sciences. However constant we keep our stimulus, then, and the other external conditions (the physical light or sound source, *e.g.*, and the general physical surroundings), the report will change in a definable way from moment to moment and from observation to observation. To obtain a "true measure" of function, therefore, a certain stimulus-difference [17] will be

[17] For simplicity's sake we may omit in exposition the presence-absence observations which involve no new principle of measurement. The psychophysicist also employs what he calls the "gradation methods," in which the experimenter begins with a large and obvious difference of stimulus, gradually reduces it beyond the point where the observer finally reports "like" or "the same," and then begins again with equality and passes in the opposite direction, by a similarly graded series, to the point of "unlikeness." An approximate and provisional limen is calculated by averaging the first "like" report (in terms of the stimulus-difference) and the first "unlike" report when moving in the opposite direction. Since these two (averaged) values are each subject to the accidental errors, a "true" limen requires many repetitions and a final calculation under the provisions of the law of error. So we come finally (unless the provisional limen is sufficient for our purpose) to the theory of the "error methods," as these are given in outline in the text. For a comparison of the modes of observation and of the means of calculation in the two types of method, see Urban, *Archiv für die gesamte Psychologie* (1909), Vol. XV, pp. 261*ff.*; (1910), Vol. XVI, pp. 168*ff.*; *Psychological Review* (1910), Vol. XVII, pp. 229*ff.*; G. H. Thomson, *British Journal of Psychology* (1912), Vol. V, pp. 203*ff.* (esp. pp. 210-212); S. W. Fernberger, "On the Relation of the Methods of Just Perceptible Differences and Constant Stimuli," *Psychological Monographs* (1913), Vol. XIV, No. 4; whole No. 61 (esp. pp. 78-81).

presented over and over and a long series of reports recorded. Let us suppose that the reports concern intensity and that they fall out "unlike," "unlike," "like," "unlike," "like," "unlike," "unlike," etc. If the stimulus difference happens to have been liminal, the probable distribution of 1,000 reports will be 500 "unlike" and 500 "like" (and "uncertain").[18] Where the reports fall out in some other proportion (as they practically always do), the liminal difference of stimulus is reckoned by statistical procedures from the actual distribution obtained. If the stimulus difference chosen is less than liminal, then the chances are that less than 50 per cent of the reports will be "unlike"; if the difference is greater than liminal (supra-liminal), then more than 50 per cent.

Often, in practice, not a single pair but several unlike stimuli are used. The principle of calculation of the limen is the same. In the common method of "right and wrong cases" (or method of "constant stimuli") it is customary to employ 1 standard stimulus and 5 or 7 comparison stimuli, the latter being compared, one by one, with the standard, in a haphazard order. Thus, where the liminal difference for lifted weights is sought, the weights may be as follows: standard 1071 grams, comparison weights 921, 971, 1021, 1071, 1121, 1171, and 1221 grams—*i.e.*, one comparison weight is identical with the standard; two differ from it, above and below, by 50 grams; two by 100 grams, and two by 150 grams. The accompanying table is a sample of the way in which the reports "less," "greater," and "equal" (and "uncertain") are distributed, where the standard is compared 100 times over with each of the seven comparison weights

[18] The disposition of the "uncertain" and "doubtful" reports has long vexed the student of psychophysics. As an introduction to the literature of the subject consult Fernberger, *American Journal of Psychology* (1914), Vol. XXV, pp. 538*ff.*; S. S. George, *ibid.* (1917), Vol. XXVIII, pp. 1*ff.*; and Boring, *Psychological Review* (1920), Vol. XXVII, pp. 440*ff.*

(700 reports in all, exhibited in terms of the standard weight):

NUMBER OF TIMES STANDARD (1071 GRAMS) IS REPORTED

Less than	Equal to	Greater than	the Comparison Weight	Total Number of Comparisons
1	8	91	921 grams	100
6	11	83	971 grams	100
10	37	53	1021 grams	100
30	37	33	1071 grams	100
55	34	11	1121 grams	100
76	20	4	1171 grams	100
90	9	1	1221 grams	100

It appears from the table that even the very largest difference of stimulus (1071 + 150 grams) did not *always* lead to the report "different," *i.e.*, the standard was reported "greater" than the 921-gram weight in 91 of the 100 cases and less than the 1221-gram weight in 90. The corresponding numbers for the 100-gram differences were 83 and 76, and for the 50-gram differences 53 and 55. Since the standard was reported "greater" than the next lighter weight (1021 grams) in 53 per cent of the cases and "less" than the next heavier weight (1121 grams) in 55 per cent, it looks as if [19] the liminal difference (the difference calling for one-half "different" reports and one-half "not different" reports) would fall somewhat short of the smallest difference used; namely, 50 grams. After eliminating the constant error of time (from the orders "standard-comparison" and "comparison-standard"), the appropriate application of mathematical processes, based upon the law of error, gives, in this instance, a lower limen of 38.39 grams and an upper limen of 33.52 grams. The difference between these limens (38.39 — 33.52), called "the interval of uncertainty," is

[19] All seven comparisons must be taken into account in calculating the limen.

4.87.[20] This is taken to be the (inverse) measure of the psychosomatic function involved.[21] These determinations are given further significance by appending to them a measure of precision or accuracy, reckoned by the mathematician as the "probable error" or some other related value. As the measure of precision in our instance is relatively large, we may be reasonably certain that the liminal value is accurate.

Thc Refinements of the P-Methods

This brief characterization of the psychophysical methods implies that they are refined tools of measurement. They are refined, first, on the side of observation, demanding high training and great competence on the part of the observer—training which includes the ability to assume and to maintain a constant attitude toward a specific and highly technical task and to detect any inevitable shift in that attitude. This requirement of the trained and competent observer is shared also by the physical sciences, save that in them the measure of physical change or of physical capacity may, under some circumstances, be automatically and mechanically recorded. The methods are refined, in the second place, by the stand-

---

[20] It is impossible to find the limen by simply taking a proportionate amount of that stimulus difference (50 grams) which gives 53 per cent (or 54 per cent) of "different" reports. This is because the type of distribution assumed by the law of error provides that various stimulus magnitudes should have varying effects upon the capacity for discrimination. For the application of the law of error in the "error" methods of psychophysics, *see* E. B. Titchener, *Experimental Psychology* (1905), Vol. II (*Quant.*), Pt. I, pp. 38*ff.*, 92*ff.*, 106*ff.*; E. G. Boring, *American Journal of Psychology* (1917), Vol. XXVIII, pp. 280*ff.*, 465*ff.*, and W. Wirth, *Spezielle psychophysische Massmethoden* (1920). Our instance is taken from Titchener, *op. cit.*, Vol. II, Pt. I, pp. 106*ff.*

[21] The limit of performance may also be expressed in the three psychometric functions of Urban, which display the total probable distribution of the "greater," "equal," and "less" reports under change of the stimulus-difference.

ardization of the experimental conditions. Stimuli must be held constant and expressible in reliable units. If light or sound, then of given wave-length or amplitude; if weight, then in known mass and with a fixed value for the receptor apparatus of the body; if odor, then of known chemical constitution and of known diffusibility. Thus both the state of the organism and the extra-organic conditions are simplified and standardized. Finally, the refinement applies to the mathematical means of calculation. The individual report is regarded as a sample, subject to the laws applying to large numbers of homogeneous phenomena. From the application of statistical means the methods seek to derive representative values which are designed to measure the specific limit in question together with the degree of accuracy or precision with which the measure has been taken. The earlier applications of the *P*-methods were mainly directed toward the establishment of uniformities between sense-distances and the properties of stimulus. It was this quest which led to the generalization of Weber's law. But the usefulness of the methods is by no means confined to the verification of that law. The application of them is, instead, determined by the three sorts of scientific refinement just enumerated, *i.e.*, accurate and repeated observation under a task, control of outside conditions, and appropriate statistical treatment. In setting forth the methods of quantitative psychology in 1905, Titchener expressed the opinion that any psychological problem could be attacked "on the quantitative as well as on the qualitative side." He suggested as instances the treatment of brightness contrast, of simple feelings, of illusory perception, and of memorial "retention." Now in view of the wide current use of other quantitative methods in related problems of zoölogy, genetics, education, and the study of the abnormal, it may be well to insist that the spirit and the principles of the metric methods restrict their proper application to conditions under which our three refinements may be pre-

served. As we shall presently see, the loss of these refinements profoundly changes—so far as psychology is concerned—the character and the significance of quantitative procedure.

Uses of the P-Methods

A typical application of the *P*-methods has been made to the study of action; chiefly relating to the speed and accuracy of movement in the automatized forms and in the temporal limits of the impulsive and selective types of action. In that quantitative study of action known as the "reaction experiment" (p. 281), the observer is instructed to make a prescribed movement (such as the depression of a telegrapher's key) upon an appropriate occasion, say, the exposure of a light-flash or the hearing of a sharp click. The instruction also includes the attitude to be assumed toward the flash or the sound as well as toward the movement. A certain organization of experience, then, and the character of the preparatory set are carefully arranged. In short, the whole instruction and the setting of the experiment are designed to produce in the trained observer a particular type of action, *e.g.*, the complete sensorial, the abbreviated muscular or motor, or some form of selection. The experimental arrangements thus make it possible to measure in units of time consumed, in accuracy, and in form of distribution, the limit of an executive function of the organism. As in the case of the apprehension of difference, so here also the accidental errors play a part. The duration of any given form of action is subject to them and therefore a large number of repetitions present a characteristic mode of distribution.

The experimental literature of the last three decades contains a great number of quantitative studies of "acquisition," of illusory perception, of work, of attention, etc. Often the metric methods have been modified to suit the individual problem; and not infrequently they have been simplified by

reducing the statistical treatment.[22] The chief representative values for the measure of limit have then been the "average" and the "mean variation." Where the methods have been used in their strict form, the high constancy of certain of the measures obtained suggests that they rest upon the simplest and purest forms of function which any method has been able to isolate in the field of psychology.

In the emotional forms of execution, in true memory and imagination, and in comprehension and thinking, the functional capacities have scarcely been touched by the stricter methodical procedures of the quantitative kind. Although these functional performances are, for the greater part, fairly complex, it is altogether likely that careful attention to the three refinements mentioned above will result in further wide extensions of our scientific knowledge of the psychosomatic limits of the organism.

The Methods of Test (T-Methods)

The second large group of quantitative methods devised to measure "capacity" includes the "tests." The common designation "mental test" has of necessity to be taken in a qualified sense since it is obvious here as elsewhere that no independent "function" of mind alone is responsible for our measurable performances. At the most, the test is designed to suggest or to indicate some kind of psychosomatic limit or limits and to detect relations and dependencies of "capacity." At the least—and here most testing ends—all that is derived is a quantitative estimate of accomplishment which may have a technological value in business, medicine, education, or some other form of practice; but with no precise indication either of the mental and organic factors involved or of the precise mode of performance.

---

[22] *Cf.* E. B. Titchener, *Experimental Psychology* (1905), Vol. II (*Quant.*), Pt. II, pp. 405*ff.*

Underlying Principles of the T-Methods

We make a brief survey of the principles of measurement utilized in the *T*-methods, bearing always in mind the fact that our interest is wholly confined to the *psychological* implications of the tests and that it does not therefore include the use or the value of them in education, business, or elsewhere.

Testing measurements assume, as the psychophysical metric methods have assumed, certain forms of distribution among comparable numerical results collected in large numbers and subject therefore to statistical treatment. The treatment bears both upon the entire group of results and upon the position of the individual "measure" within the group. Let us consider these two parts of the statistical task.[23]

1. The chief representative values for the group or mass are measures of *general tendency* (the average, the median, the mode), *i.e.*, the drift of the entire mass toward a central value, and measures of *variability, dispersion or scatter* (average deviation, standard deviation, "probable" error). The ordinary "bell" curves represent the same symmetrical type of distribution about a central measure (the mean); but they show various degrees of variability or scatter. Since

[23] No attempt is made here to give an exposition either of the conditions under which the tests are given or of the statistical processes by which the results are treated. Representative accounts of the methods will be found in G. M. Whipple, *Mental and Physical Measurements* (1914), Pt. I, pp. 14-60; E. L. Thorndike, *An Introduction to the Theory of Mental and Social Measurements* (1912), 2nd ed., and *Educational Psychology* (1914), Vol. III, pp. 152*ff.*; W. Brown and G. H. Thomson, *The Essentials of Mental Measurement* (1921), pp. 97*ff*. A current and complete exposition would also include a discussion of partial coefficients, hierarchical order, means of correction, etc. For a general account of the statistical methods as they appear in biometrical studies, consult K. Pearson, *The Grammar of Science* (1911), 3rd ed., Pt. I, pp. 113-178; and for the statistical methods at large, *see* G. U. Yule, *An Introduction to Statistical Methods* (1922), 6th ed.; A. L. Bowley, *Elements of Statistics* (1907), 3rd ed.; W. P. and E. M. Elderton, *Primer of Statistics* (1910).

the measures of general tendency and of variability characterize an entire assemblage of individuals, they somewhat resemble the specific or generic "characters" by which the systematic botanist describes an entire group of variable plant individuals. It has been discovered by actual testing that many of the distributions of accomplishment under the test-tasks approximate, when the results are taken in relatively large numbers, the "normal" type of distribution, which has also been exemplified in death rate, disease, and stature, and in various problems of economics and public finance. They represent distribution according to "chance" or "probability"; and they assume that the individual measures of the group are determined, in part, by a large number of small and independently variable factors combined in every possible way, just as in the "error" methods of psychophysics. The normal type of distribution is represented by Gauss's law of error. It is demonstrated in a striking way by Galton's falling-shot frame, where the "chance" factors include the way in which the shot is poured in at the top, the shape, size, and weight of the individual leaden spheres, and the arrangement of the pegs upon which the shot falls.

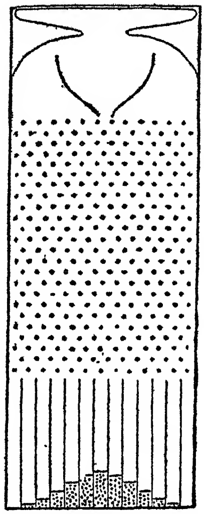


FIG. 32. MECHANICAL REPRESENTATION OF "NORMAL" DISTRIBUTION

Shot placed in the funnel at the top finds its way downward over small pins to the piles at the bottom. From F. Galton, *Natural Inheritance* (Macmillan Co., 1889).

2. But the statistical methods seek, further, to determine the position and the significance of the individual measure, as well as to characterize the entire group. This determination is made possible by relating the individual or the "trait"

(1) to the general central tendency and (2) to the variability or dispersion of the entire group. Thus instead of saying that a given person tested is "good," "poor," or "deficient"; "slow" or "quick"; "dull" or "bright," as regards any one of the aptitudes sought in the days of "mental types," it is possible to say (1) that he stands, in some specific accomplishment, 3 (or 5 or 12) points above or below the average or the mode, and (2) that his deviation from the average or the mode bears a certain relation to the probable error or the standard deviation for the entire group. In a concrete case, these statistical refinements may mean that an individual *A* has correctly spelled, in a contest among 100 persons, 2 (or 7 or 14) more words than the average, and in addition that he exceeded the average accomplishment to a degree that was attained by only 10 (or 6 or 2) of the 100 contestants. The individual accomplishment thus takes on an added significance when it is related to the mass performance of many comparable individuals. The measures representative of the individual have been more used in the tests than in the *P*-methods. In the former the demands of practice—particularly of education and of the study of defect—make it important that the individual should be given a rating or *status*.

The Correlation of Test Results

The stricter methods of measurement have been given a useful—if liberal—extension by the procedures of "correlation," which seek to express, with a high degree of probability, a kind of relationship among individuals which cannot be directly measured by fixed units of "distance" or disparity. Thus a certain moderate degree of association between stature and weight obtains, due to uniformities of inheritance and growth. It is not possible, to be sure, to predict that a given man 5 feet, 11 inches in height will weigh exactly 172 pounds; but it may be possible to express by such a decimal

number as $r = 0.66$ (coefficient of correlation) the fact that the conditions which determine stature also have, to a considerable extent, an influence upon weight; and so to fix the probable relationship between the two characteristics. In this case (to explain more specifically) the decimal 0.66 indicates the probability that our man of 5 feet, 11 inches who is above the average *height*, will be a corresponding amount above the average of his class in *weight*. If it is proper to speak of this value r as a "measure," we shall have to say, not that it measures the individual man, but that it measures the probability that, in his case, the concomitant variation of height and weight will be exemplified.

If the relationship between the phenomena to be correlated is direct, invariable, and perfect (as the relation between rise in temperature and increase in length of a metal rod), the numerical expression (coefficient) is $+1.00$; if negative, invariable, and perfect, then -1.00; and if no relation obtains, so that the appearance of the one phenomenon is wholly independent of the appearance of the other, correlation is absent and it is expressed by the coefficient 0.0. In many of the facts investigated by the statistical processes used in psychotechnics, some positive relation obtains (coefficients between 0.0 and $+1.00$), and the probability that this connection is present is expressed in terms of correlation. As it is important to know, in the measurement of sense distance, how closely successive series of *P*-results from a single trained observer are correlated and how much they vary under fatigue or practice, so in the tests it is obviously more satisfactory to discover that one performance, *e.g.*, the naming of logical opposites, is correlated with sentence completion, with the *A*-crossing test, and with adding, to the extents of 0.85 and 0.58 and 0.70 (respectively), than to speak vaguely of a type-complex as "attentive-and-persistent," "erudite," or "stable," which somehow affects the degree of accomplishment in all these directions.

CORRELATION OF RESULTS OF INTELLIGENCE TESTS

	Dotting	Alphabet	Sorting	Dealing	Spot pattern	Tapping	Mirror drawing	Sound discrimination	Line discrimination	Touch discrimination	Memory	Weight discrimination
Dotting		77	67	69	57	57	50	52	48	38	20	16
Alphabet	77		74	66	59	53	29	52	16	62	31	07
Sorting	67	74		72	45	61	34	52	14	22	19	23
Dealing	69	66	72		51	65	40	34	47	23	19	01
Spot pattern	57	59	45	51		41	45	47	25	03	26	11
Tapping	57	53	61	65	41		45	47	08	26	—05	22
Mirror drawing	50	29	34	40	45	45		34	16	08	05	—05
Sound discrimination .	52	52	52	34	47	47	34		—07	—01	01	—13
Line discrimination ..	48	16	14	47	25	08	16	—07		26	06	19
Touch discrimination .	38	62	22	23	03	26	08	—01	26		16	29
Memory	20	31	19	19	26	—05	05	01	06	16		05
Weight discrimination	16	07	23	01	11	22	—05	—13	19	29	05	

The advantage of relating the various tests, in order to interpret and to understand the raw results, and also the practical convenience of knowing how various "abilities" go together in the individual have combined to bring the methods of correlation into great prominence. An elaborate methodology has grown up under the inventive suggestions of Pearson, Yule, Spearman, Thomson, and others. A typical group of correlations (not, however, to be regarded as final!) is shown in the table opposite.[24] It is important to note that such figures represent probability only, that they are applicable to fairly large numbers, and that they are not—at least not usually—to be taken as measures of the capacity of a single individual person. As regards accomplishment, the degree of correlation indicates only the chances that the degree of one proficiency (as measured by deviation from the central tendency in one performance) will be associated with a certain other proficiency (as measured in a similar way). It no more predicts concomitant proficiencies in the individual person than the tables of mortality, upon which the life insurance companies base their premiums, can prophesy that a given individual of forty-five years will live to the age of sixty-seven. Thus when Whipple, comparing the strength of the right-hand and the left-hand squeezing grips of 50 boys came out with the coefficient = 0.92, and an extremely small probable error, he showed that—at least for his group—a strong right-hand grip was very likely to be associated with a correspondingly strong

[24] The table is from Hart and Spearman (*British Journal of Psycology*, 1912, Vol. V, p. 54), with the coefficients for "imputed intelligence" omitted. Although these authors give the figures as from Burt (*ibid.*, 1909, Vol. III, p. 161, table v), they depart from Burt (without notice) in 11 places in the table, thus making the two sides of the table consistent. There appears to be a confusion in Burt's figures for "imputed intelligence" and "dealing." If Burt's figures on page 177 are to be trusted, then Hart and Spearman would seem to be wrong upon four coefficients; *viz.*, dealing-sound, alphabet-tapping, mirror-tapping, and mirror-spot pattern.

left-hand grip, a weak with a weak, and so on.[25] When we take the boys individually, however, we find a wide range of likeness and difference in the strength of the two hands. Thus one boy, Number 25, falls 14 points short of the average squeeze for the entire group (283), when he uses his right hand; but with his left hand he *exceeds* the average left-hand squeeze (273) by 35 points. This wide difference[26] puts him in 38th place (among the 50 boys) with the one hand, but in 23rd place with the other. Of course, since the degree of right-left correlation is very high ($r = 0.92$) and the right and left grips about equal, it seems to follow that many of the other 49 boys must have exhibited a much higher ambidextrous balance.

Correlation is, then, a "tendency toward concomitant variation," and the coefficient of correlation is the measure of that tendency displayed in a mass or group. If we are directly to apply the measure of it to the individual person or trait, then we must derive two or more whole schemes of distribution from that person or trait and apply the statistical processes, as in the *P*-methods. Generally, however, the coefficients given in the test-studies are to be interpreted as tendencies toward concomitant variation within an entire group.[27]

The Significance of Correlations

Upon the significance of positive correlation, *i.e.*, of like *plus* or *minus* deviations from the median or mode, the exponents of the *T*-methods have spoken with a good deal of emphasis. Some degree of relationship of this kind, under different test-tasks, appears in a large number of the tests,

---

[25] G. M. Whipple, *op. cit.* (1914), Vol. I, p. 16.

[26] Possibly he was a left-handed boy who played about his father's blacksmithy.

[27] For a method of arriving at the most probable concomitance for a single individual, given the correlation for the group, *see* W. Brown and G. H. Thomson, *The Essentials of Mental Measurement* (1921), pp. 99*ff*.

as well as between the test-results and the gross estimate of teachers, wardens, and other "experts." Before these correlations can be finally interpreted, however, various critical scruples have to be satisfied. (1) Many correlations are too small or too inconstant to be immediately significant; (2) some of the higher correlations differ widely with different formulas of computation, different methodical procedures, and different testing conditions;[28] (3) a high correlation does not necessarily imply that the chief causal factors involved in two performances are involved in common;[29] and (4) to refer correlated results to their corresponding test-labels ("opposites-test," "cancellation-test," "substitution-test," and the like) is not to supply any *descriptive* account of "mental functions" or of the several aspects of "intelligence." In view of these difficulties in deriving and interpreting correlations, it is not surprising that the students of the *T*-methods should hold widely divergent views upon the psychological meaning of the results. To these divergent views we shall return.

We progress one step further from the rigorous conception of measurement when we pass to the method of *rank differences* or the method of *coördination.* This method may be applied where no scale and no units are available. It is sometimes applied where no "magnitude" of the accomplishment is at hand, but only a serial order, as when men are placed in a row in the order of apparent height. Whipple made a rank-order of his 50 right-hand grips and another of his

---

[28] *Cf.* W. Brown, *British Journal of Psychology* (1913), Vol. VI, pp. 223*ff*.

[29] *Cf.* C. Rosenow, *Psychological Review* (1920), Vol. XXVII, pp. 147*ff*. "Consider, for example, the effect of the moon, the sun, and the planet Jupiter upon the height of the tides. If we were able to measure with absolute accuracy the influence of each of these heavenly bodies, the partial correlation between the position of Jupiter and the height of the tides would be well-nigh perfect, but the relative importance of the position of this planet would be negligible" (p. 150).

50 left-hand grips. In spite of the large displacement of our single 25th boy (38th in one list and 23rd in the other), there was found to be, in general, a close resemblance in rank throughout the group. The differences of rank which were found were treated by an appropriate formula[30] and made to yield a measure of coördination of muscular ability, a measure which Pearson has shown to be, at least in statistical theory, reducible to *r*, the coefficient of correlation. The method has been much used for pooling the rough opinions of several judges, *e.g.*, the various teachers of a group of pupils.[31] Thus Spearman,[32] testing in certain English schools, asked the teachers to arrange in point of excellence the pupils under them, and then he correlated the rank-order of the judgments with the results of his tests.

What Do the Tests Measure?

Those who use the testing methods sometimes contend that to measure accomplishment is at the same time to measure "ability"; that under specified and controlled conditions "the measure of ability and the measure of performance have synonymous meanings"; that "for every performance there

[30] Whipple, *op. cit.* (1914), Vol. I, p. 41; Brown and Thomson, *op. cit.*, pp. 102-103. An error which arises from the fact that the difference between adjacent ranks (1-2, 20-21, 49-50) is not a constant quantity has been calculated and allowed for by Pearson.

[31] The defects and the limitations of the "rating" method are set forth by H. O. Rugg (*Journal of Educational Psychology* (1921), Vol. XII, pp. 425, 485; (1922), Vol. XIII, pp. 30, 81*ff.*), who notes that rating leads to a measured estimation of "character" only under exceptional conditions. As regards the rating of army officers "under carefully controlled conditions," Rugg concludes that "it is practically impossible to secure ratings on point scales which are reliable estimates of character" (487). He recommends that "loose methods of rating" be discarded "once and for all" in education (426). Another recent estimation of the method will be found in H. Bogen, *Zeitschrift für angewandte Psychologie* (1922), Vol. XX, pp. 153*ff.*

[32] C. Spearman, *American Journal of Psychology* (1904), Vol. XV, pp. 246*ff.*

is a corresponding degree of ability."[33] But such an equation can only mean that "ability is ability to do"; that an individual performs as he is able.[34] There is no harm in this tautology unless "ability" is illicitly made to stand for something more than readiness to perform. That is a real danger. The writer just now quoted, *e.g.*, speaks of "certain mental processes or abilities" and he declares that a significant measurement implies that "the performance secured must be the product of the functioning of certain mental processes" (p. 22). Thus "ability" passes from the undescribed condition of "being able to perform up to the limit" to hypostatized "mental processes" which are *assumed* to be responsible for the functionating. The concept of "intelligence" is, as we shall presently learn, such a "mental" cause, assumed to account for performance under test. Now "ability" taken in the first sense (a mere corollary to performance) is legitimate; and it is, as it appears, a term of great practical usefulness in education. But "ability" of the second kind, ability become a power or faculty of mind, is not so easily legitimatized. The amount and accuracy of silent reading—to make the matter concrete—may be taken as a measure of the ability to read silently (always under the stated conditions); but not as the measure of a "reading function" of the mind.

In order to understand the *psychological,* as distinguished from the *technological,* significance of the testing methods, it will be advisable to glance at their history.

The Beginnings of the Tests

The proposal to "test" human beings suggests that the degree of accomplishment varies from occasion to occasion

[33] W. S. Monroe, *An Introduction to the Theory of Educational Measurements* (1923), p. 19.

[34] Monroe agrees with those who define "intelligence" as "ability to learn."

and from individual to individual. It is natural, therefore, that the methods of test should have developed in connection with an "individual" or a "differential" psychology; or, as it is widely known, with the "psychology of individual differences." Long before the experimental methods of the sciences had been extended to the facts of mind striking dissimilarities among men had been remarked. For the greater part these differences were of social import, and they usually denoted opposite extremes of endowment. Men were distinguished as good and bad, reliable and shifty, bright and dull, affable and taciturn, nervous and phlegmatic, quick and slow, honest and dishonest, selfish and unselfish, and so on to encompass the whole "character." It is obvious, however, that these designations, though highly significant in practical affairs, did not indicate real psychological distinctions. They were both gross and extreme. Worked over for centuries in ethical, social and literary depictions of human beings, they never became incorporated in a sound descriptive psychology. One of the first serious attempts to supersede them was made by the English anthropologist and student of inheritance, Francis Galton. Galton proposed to distinguish men in terms of more specific endowments, as by the type of imagery peculiar to the individual. He sought also to discover the empirical distribution of talents among persons, classes, and races. His work encouraged the distinction of "mental types"; and furthermore it went to show that the limit of accomplishment was set, at least in part, by racial and heritable factors.[35] On the side of technique, Galton contributed mathematical methods and instruments for determining and expressing the various degrees of ability to be found in a given group or "population."

But there was also another source of material waiting to be turned to account in "individual" psychology. It came

[35] F. Galton, *Natural Inheritance* (1889); *Inquiries into Human Faculty and Its Development* (1883), and *Hereditary Genius* (1892).

from a host of experimental studies made in the new psychological laboratories during the last two decades of the last century. Many researches included a section upon the "individual differences" of the observers employed; differences in sensory discrimination, in the accuracy and quickness of perception and of movement, differences in the rate and the range of memory, imagination, attention, and the like. Although these differences were by-products and of secondary importance to the results which were common to all the observers, they came in time to be regarded for their own sake and were set down to the credit of a new *differential* psychology. This new psychology received plenty of encouragement from the outside; especially from education and medicine, because it promised to have great practical consequences. Education sought a doctrine of differences for its pupils, as well as a means of fitting its schools to the children. Medical men, notably the students of mental disease, felt the need of diagnosis and of classification. Moreover, general human interest in the individual and his capabilities counted much more emphatically upon the side of a differential psychology than upon a universal and impersonal description of mental "processes" and of the functions of the organism.

The Psychology of "Types"

There appeared, then, chiefly in the two decades bounding the turn of the century, a psychology of types which undertook to classify in a qualitative way the gross differences among men.[36] Galton's proposal of fundamental differences in imagery (ideational types), supported by the independent

---

[36] L. W. Stern, *Ueber Psychologie der individuellen Differenzen,* etc. (1905), pp. 40*ff.*; *Die differentielle Psychologie,* etc. (1911); M. T. Whitley, "An Empirical Study of Certain Tests for Individual Differences," *Archives for Psychology* (1911), No. 19, pp. 1-7.

observations of Fechner [37] in Germany and of Charcot [38] in France, proved fruitful in the laboratory. Notable differences were discovered in the range and vividness of imagery; in the use of imagery in memory, imagination, comprehension, and thinking, and in the relative amounts of visual, auditory, and kinæsthetic processes. Nevertheless, these differences turned out to be not so great and not so constant as to form a series of consistent types; and besides, other mental and psychosomatic differences did not run with them.[39] It could not then be predicted that a person of (say) pronounced visual type would always use his visual resources, whether he read, sketched, or wrote, remembered dates, poems, or faces, or devoted himself to daydreaming and invention. Neither did it hold that a plentiful and vivid imagery of one kind or another was generally diagnostic of other mental characteristics. Virtually the same can be said of the types of action, of the fineness of discrimination, of memory, of association, of understanding, of attention, of judgment, and of feeling. The quest for types led to many important psychological facts; but it did not—as many investigators hoped that it would—lead to any single formula or device which could be used to distinguish, or so much as to indicate, the general constitution of the individual.

The failure of psychology to classify minds by "prescription," by the contention that one individual possesses certain traits (honesty, conscientiousness, self-control, objectivity, and the like) and another individual certain other traits, does not mean that the method of qualitative distinctions was immediately or wholly abandoned. Its *practical* usefulness is

---

[37] G. T. Fechner, *Elemente der Psychophysik* (1860), Vol. II, pp. 469*ff*.

[38] J. M. Charcot, *Leçons sur les maladies du système nerveux.* Oeuvres complètes (1886-90), T. III.

[39] M. R. Fernald, "The Diagnosis of Mental Imagery," *Psychological Monographs* (1912), Vol. XIV, No. 1; whole No. 58, pp. 130*ff*.

apparent. Precisely such distinctions as these possess great human value. They are social and ethical valuations. They do represent the directions wherein the individual is either satisfying, useless, or positively disappointing and troublesome to his fellows. The mistake of making these "value-traits" equivalent to "mind" or to "mental capacity" is clear upon disinterested reflection. And the mistake flagrantly appears when the statistician proposes to prove, by an appeal to them, that "mind" is heritable, as the body is. Thus Karl Pearson, in his study of brothers and sisters in school, took the teachers' estimate of ability, vivacity, conscientiousness, popularity, temper, self-consciousness, assertiveness, and handwriting. Applying a method of correlation to these opinions submitted by the teachers, Pearson discovered that the ratings for pairs of children in the same family showed a degree of similarity in these "mental and moral characters" approximately the same (coefficients about 0.50) as was shown for such physical characteristics as color of eyes and hair. This likeness he accounts for by reference to hereditary factors.[40]

The more general failure to discover a single differential unit or factor of any sort which should serve to typify, or to be symptomatic of, the individual mind led to the quest for an inclusive *complex type, i.e.,* for a *composite* delineation of mind on its various sides (discrimination, memory, fancy, action, work, feeling, etc.). This qualitative psychology of type-complexes came to its finest fruition in Binet's elaborate study of his two young daughters (*L'Etude expérimentale de l'intelligence,* 1903), in which he attempts to integrate various characteristic differences appearing in a score of simple

[40] K. Pearson, *Biometrika* (1904), Vol. III, Pt. II, pp. 131*ff.* For a criticism of Pearson, *see* E. L. Thorndike, *Educational Psychology* (1914), Vol. III, pp. 237-242. Pearson's coefficients were later found to stand in need of correction. They were, after all, based merely upon opinion, and they could not substantiate the wide induction of the author in regard to "mental inheritance."

observations and experiments. The type exemplified by Marguerite he calls *stable,* while Armande represents the *variable* type. The study displays much acute observation; but it is rather literary and divinatory than scientific, and it cannot be said to lay the foundations for a serious psychology of individual differences. Again, the speculative and highly socialized psychology of Freud and his followers has often been inclined (possibly on account of its clinical interests) to distinguish human beings by way of general and complex types. The contrasted classes of the *introverts* and the *extraverts,* worked out with great elaboration by Jung,[41] represents this inclination. Both of these attempts suggest the old common sense designation by opposites. Such contrasts in human endowment and tendency are doubtless to be found; but they seem to be rare and highly selective, and not well adapted, therefore, to represent the whole graded range of "mental" difference. A more scientific and empirical attempt to distinguish type-complexes is represented by Kraepelin on the analysis of the "work curve" in the dynamic performances of the organism.[42] Kraepelin has carried out his proposal in a long series of laboratory studies of mental defect in his journal *Psychologische Arbeiten.*

Tests and "Intelligence"

After the period of "types"[43] we come to the era of "intelligence." The search for qualitative differentiæ of mind gave way in many quarters to an effort to denote the individual by representative numbers indicative of his "intelligence." Men sought by the quantitative methods of "test"

---

[41] C. G. Jung, *Psychologische Typen* (1921); Eng. Ed., 1923.

[42] E. Kraepelin, *Psychologische Arbeiten* (1896), Vol. I, pp. 14*ff.*; W. Wundt, *Die Grundzüge der physiologischen Psychologie* (1911), 6th ed., Vol. III, pp. 587-596.

[43] The distinction of "periods" or "eras" is not to be taken too literally. Not all of the earlier students of differential psychology believed in "types"; and not all of the later adherents of the *T*-methods

to indicate the degree of this endowment. Here the concept of the limit of function, of "capacity" in our sense, appears much more clearly defined than in the quest for types. The degree of intelligence has, during this recent period, been taken to stand for maximal accomplishment under given prescribed conditions.

It would be a mistake to suppose that psychology found in "intelligence" a new and unfamiliar concept. The word has for centuries been commonly and widely used to indicate a certain gross alertness and intellective competence which has a high value in social relations, and especially in education. It was in this gross and ill defined sense that the term was taken over into the psychology of tests. Attempts were made to measure by test differences which the school teacher and the employer of men roughly distinguished as "high" and "low intelligence." Some attempts were of the "all-round" or "many-aspect" kind, seeking from numerous unrelated exercises to get a consolidated estimate of the "intellectual functions." The most notable proposal of this kind is to be found in the conglomerate exercises and informal examinations of Binet. Other men sought the same end by the use of a single test or by a group of closely related tasks, believing that some typical performance might be found which should be diagnostic of the individual's whole range of abilities.

Since the methods under consideration have been widely based upon these conceptions of "intelligence," we shall hardly come to terms with them until we have reviewed the use made of that term by men responsible for the develop-

have espoused "intelligence." Nevertheless, the general shift of emphasis is obvious enough to make the distinction of the text significant. The student of the history of psychology should bear in mind the fact that the terms "test," "type" and "intelligence" really belong to anthropometry and that they have been adopted in certain branches of statistics and of education. They have never been naturalized within psychology itself.

ment of the tests. We begin with some of the earlier definitions of the period.

For Ebbinghaus the essence of intelligence lay in an *integrative activity* (*Kombinationsactivität*), which this psychologist proposed to test by means of the "completion method." His subjects were instructed to fill in appropriate letters, words, or phrases, to the gaps of mutilated sentences.[44] Binet had a broader conception of the term. Whereas he sought in his intensive individual study of the type-complex of his two daughters to summarize many traits under the terms "stable" and "variable," his problem of measuring ability of children-in-the-mass, normal and defective, led him to seek a quantitative expression, called by him "mental age," for the total resources of the "intellect." Nearly all the things with which the psychologist has to do are, as Binet maintained,[45] phenomena of *intelligence*; sensations and perceptions, as well as reason. But of all the phenomena, it is "judgment" which is most important for everyday life. He does not propose, therefore, to waste time upon the measurement of sensation, the simplest manifestation of *l'intelligence*. Memory itself is included in his tests only to gain an appreciation of "judgment"—a word variously and loosely construed by Binet as "common sense," "practical sense," "initiative," the "faculty for adaptation," "comprehension," and "reason." Binet's vacillation between "intelligence" regarded as "everything cognitive" and as "judgment" (grossly synonymous with the English "intellect" as distinguished from the "senses") has done much to bring ambiguity, mystery, and misunderstanding into the use of the

---

[44] H. Ebbinghaus, *Zeitschrift für Psychologie* (1897), Vol. XIII, p. 401. For an account of the procedure and a criticism of the results, *see* G. M. Whipple, *Manual of Mental and Physical Tests* (1915), Pt. II, pp. 283*ff*.

[45] A. Binet and T. Simon, "Méthodes nouvelles pour le diagnostic du niveau intellectuel des anormaux," *L'année psychologique* (1905), Vol. XI, p. 196.

term. Binet was himself mainly interested in the *intellect,* and thus the word *intelligence* is (at least usually) to be translated from his French writings.[46] Since both Ebbinghaus and Binet were under commission to solve problems connected with the schools (Ebbinghaus for fatigue during the school session and Binet for the classification and instruction of the mentally deficient), it is natural that their two conceptions of "intelligence" and their tests of "mental capacity" should be of an intellective order.

As every one knows, Binet collected a wide variety of simple exercises (setting out from the lists of Blin and other predecessors) and selected as standard of reference the average accomplishment of "normal" children of various ages. The rating of his defective children was then based upon their success in the tests as related to that of the "normal" children. In the final elaboration of Binet's method, a child of ten years who passed the tests with the accomplishment of a normal child of seven, but who failed on the eight-year and subsequent examinations, was said to have a "seven-year intelligence" and to be mentally deficient or retarded by three years. Wanting a seasoned doctrine of functions, Binet hoped that a wide variety of exercises, chosen, as it appears, in a fairly haphazard and empirical manner, would indicate that fundamental aspect of intelligence which he called "judgment." Many subsequent modifications of Binet's procedure appear to rest upon the same logic and to express the same optimism upon the ultimate measurement of this or of some similar faculty.

William Stern thought Binet's designation of "intelligence" in years of deficiency from the "norm" unsatisfactory, and

---

[46] This interpretation applies to his charming and subtle study of Marguerite and Armande (1903), as well as to his tests of the intellect. In *L'étude expérimentale* he uses as terms cognate with intellect "will" and "emotivity" (305)—taken altogether a venerable trinity of the faculties.

he argued[47] that defect and superiority should be represented in the form of a ratio, thus: *mental age* ÷ *chronological age.* So reckoned, a child of ten years who just succeeded with the tests passed by most of the "normal" 7-year-olds would be given the status called by Stern the "intelligence quotient" (*IQ*) of $^{7}/_{10} = .70$. Again, a child of ten years who should succeed with the 12-year (normal) tests would be set down with an *IQ* of $^{12}/_{10} = 1.20$; and the same *IQ* would be accorded the 5-year-old who should pass the 6-year tests, an *IQ* of $^{6}/_{5} = 1.20$. Usually the quotient is multiplied by 100, a convenient value given to "normal" accomplishment. Thus the *IQ* for our retarded child would be 70, and the *IQ* for the advanced 10-year-old and 5-year-old would be 120. This use of the ratio assumes both that the "mental age" (alleged to be deducible from the tests) derives its chief significance from its relation to chronological age and that the whole range of *IQ's* (70, 100, 120 and the rest) are all measured upon the same scale and in terms of a common unit. The second part of the assumption has been widely questioned. Calendar years have constant units and are comparable; but it is not wholly clear that "mental years" are "unit" years; that a given ratio has a constant value independent of the absolute ages (chronological and mental) of the child, or that like *IQ*-distances (*e.g.,* 60 to 80, 80 to 100, 100 to 120) have a common value.[48] This is a problem simi-

[47] W. Stern, "Die psychologischen Methoden der Intelligenzprufung," in *Bericht über den V Kongress für experimentelle Psychologie* (1912), pp. 28*ff.*

[48] F. N. Freeman, *Journal of Educational Psychology* (1921), Vol. XII, pp. 3, 155; J. Peterson, *ibid.* (1921), Vol. XII, p. 148; L. M. Terman, *ibid.* (1921), Vol. XII, pp. 325, 401; H. Woodrow, *Brightness and Dullness in Children* (1919), pp. 24*ff.* For inferences concerning "mental growth" drawn from annual re-testing of individuals, *see* F. D. Brooks, *Changes in Mental Traits with Age, Determined by Annual Re-tests* (1921); B. T. Baldwin and L. I. Stecher, "Mental Growth Curve of Normal and Superior Children," *University of Iowa Studies, Child Welfare* (1922), Vol. II, No. 1, p. 61.

lar to the scaling of sense-distances which was discussed under the *P*-methods.

Stern's own conception [49] of "intelligence" differs from Binet's. It turns upon adjustment, adaptation and the resolving of difficulties. It is "general mental adaptability to new problems and conditions of life"; a mental resource which enables the organism to solve its problems and to meet untried occasions. Meumann [50] demands a creative factor in "intelligence." He realizes that the term is teleological as well as psychological, implying the accomplishment of something for a valued end; but he nevertheless finds it useful. Wundt [51] makes the guess that the "energy of attention" may represent a factor which commonly appears in many tests of "intelligence"; but he protests against the conception of a unitary "intellect" as a remnant from the psychology of Wolffian faculties.

These references to the literature of the time when testing methods were approaching the problem in a quantitative way will serve to show the diverse conceptions of intelligence. We may profitably compare these earlier definitions with a recent attempt, made in the light of two decades of testing, to redefine the term. In 1921 a number of men who had been engaged with the testing methods assembled their views upon the nature of "intelligence." The following definitions [52] were proposed; the capacity to learn (Colvin); the productive use of mental powers (Freeman); "simply a working hypothesis" (Pressey); "ability to think in terms of general

---

[49] W. Stern, *The Psychological Methods of Testing Intelligence* (English trans. by G. M. Whipple), 1914, p. 3.

[50] E. Meumann, *Vorlesungen zur Einführung in die experimentelle Pädagogik*, etc. (1913), Vol. II, pp. 714*ff*.

[51] W. Wundt, *Grundzüge der physiologischen Psychologie* (1911), 6th ed., Vol. III, pp. 597-598, 554-556.

[52] "Intelligence and Its Measurement: a Symposium," *Journal of Educational Psychology* (1921), Vol. XII, pp. 123-147, 195-216, 271-275.

ideas" (Terman); the "power of good responses from the point of truth or fact" is the "intellect" (Thorndike); capacity for knowledge and knowledge possessed (Henmon); a biological "mechanism for adjustment and control," unifying the effects of stimuli (Peterson); capacities for inhibiting and analyzing instincts and making them socially advantageous (Thurstone); "the capacity to acquire capacity" or to cope successfully with any situation (Woodrow), the capacity to profit (W. F. Dearborn); a dynamic behavioristic concept: "native capacity"; thinking or reasoning, as well as the "ability to deal with novel data" (Haggerty); the ability to learn, though it refers to the "nature of acts," not to a "central capacity" (Buckingham); "general ability to do all sorts of things" (Pintner). Of the thirteen persons who contributed definitions, eight rated intelligence in terms of the value of its *products* (*e.g.*, "good responses," "abilities making for success," "possibility of leadership," and "adaptation"); while ten (some of them defining twice) spoke of it as a "capacity" in the sense of a *power* or *potentiality* (*e.g.*, power to learn, to know, to respond well, to acquire capacity, to think and to profit).

The definitions reflect the coloring of many creeds and they suggest wide diversity of training and of interest. It is far simpler to agree to measure "intelligence" than to agree upon what to measure. The most significant aspect of these current definitions of this elusive source of accomplishment is their want of description. The psychologist learns from the recent discussions very little of the mental or organic *means* of accomplishment. Instead, his attention is drawn to empty "capacities" and to the usefulness of "intelligence" in life, school, and business. Perhaps it is better to regard the term simply as the generic or trade name for the tests and as indicative of a common technological interest. It is not quite easy so to regard it, however, while the belief remains that the use of the labels "mental," "mind," "intelli-

gence," "character," and the like, imply any necessary reference whatsoever to psychological facts or principles. At the same time, the administrator of the tests would doubtless be relieved and his own tasks advanced were he to avoid such an extraneous reference.

Alleged "Mental Functions" Tested

The test-names and the "functions" upon which they are supposed to rest fall into three classes with respect to their "psychological" reference; (1) assumed faculties (*e.g.*, memory, association, will, character), often translated of late, as in instincts, innate capacities, unit characters, or traits of mind, into the language of general biology; (2) gross descriptive terms taken, without definition, from psychological contexts (*e.g.*, impulse, reasoning, discrimination, attention); and (3) convenient names for grouping and administering the tests themselves (*e.g.*, reading tests, drawing tests, crossing out, adding, vocabulary, suggestibility, and invention). Here and there an attempt is made to give a list of the "mental functions" to be tested. Binet's primary (judgment) and secondary (sensation and perception) factors in intelligence have already been mentioned. Rossolimo[53] selects for testing nine "mental functions" which include attention, will, discrimination, memory, ingenuity, and imagination. Yerkes[54] suggests four "chief mental processes"; receptivity, imagination, affectivity, and thought, each of which includes a number of different "mental functions." Pearson[55] selects (to represent the inheritance of

[53] *See* H. C. Stevens, "A Revision of the Rossolimo Tests," *Studies in Psychology Contributed by Colleagues and Former Students of E. B. Titchener* (1917), pp. 128*ff*.

[54] R. M. Yerkes and others, *A Point Scale for Measuring Mental Ability* (1917), p. 129.

[55] K. Pearson, *Proceedings of the Royal Society, London* (1902), Vol. LXIX, p. 333; Vol. LXXI, p. 106; *Biometrika* (1904), Vol. III, pp. 131*ff*. (esp. pp. 152*ff*); (1906), Vol. V, pp. 105*ff*.

mind!) such social and domestic virtues as conscientiousness, temper, and popularity in school children. Brooks[56] assorts many ill defined mental functions—little more, in his exposition, than test-labels—into the four general classes of *simple* (handwriting, checking numbers), *memorial, higher* (opposites, language, understanding), and *informational* (vocabulary, arithmetic). Thorndike's generous list of the "functions" we have elsewhere noted. Burt[57] attributes twelve test-tasks to the following "mental processes"; perceptual discrimination, simple and complicated reactions, immediate memory, formation of associations, and attention. The "highest mental levels," the conceptual and relational, were, as he said of his tests, left almost wholly untouched. He finds "discernible but small" the correlations among the several tests falling under each of the "mental processes." He lays more stress upon their various degrees of "saturation" with voluntary attention, which is, as he thinks, the "essential factor in general intelligence."

Two decades of vigorous use of the testing methods have produced many statistical refinements. At the same time, the tests themselves have been greatly multiplied, and many ingenious testing problems have been devised.[58] It does not appear, however, that the methods have greatly increased, at least by observational means, our knowledge of the precise psychosomatic resources for maximal accomplishment. Indeed this cannot be said to be the primary intent of the methods. Some of the adherents of the tests maintain that the inquiry into *what* the tests test—aside from the direct performance of the task in hand and its diagnostic implica-

[56] F. D. Brooks, *Changes in Mental Traits with Age, Determined by Annual Re-tests* (1921).

[57] C. Burt, *British Journal of Psychology* (1909), Vol. III, pp. 98*f*.

[58] Consult the lists of J. C. Bell, *Journal of Educational Psychology* (1921), Vol. XII, pp. 103-108, and of G. M. Whipple, "Intelligence Tests and Their Use," *The Twenty-first Yearbook of the National Society for the Study of Education* (1922), pp. 93*ff*.

tions—is foreign to the methods. But there are others, as our review of recent definitions of "intelligence" shows, who are not disposed to forsake the quest for "mental functions" and for general and specific "abilities" of mind.

One means for the prosecution of this quest has come out of the methods themselves; it is the proposal to show by mathematical deduction that "general intelligence" does or does not exist and that the other resources of "mind" are certain unrelated, or else "group" factors which, taken altogether, should account for the accomplishment actually observed. We shall have to regard the general direction which this kind of mathematical argument has taken in the recent literature of the tests.

The Proposal of "General Intelligence"

The argument backward from test-score to cause or to organic and mental conditions is based upon the calculated degrees of correlation from tests and from "outside" estimates of "ability." In 1904 Spearman, observing fairly high positive correlations of this sort, contended that in all "intellectual" accomplishments a common factor, which he called "general intelligence," was involved. The degree of positive correlation chiefly derives, as he thought, from the degree to which the common factor is involved in unlike performances.[59] That the common factor had not been discovered in earlier investigations[60] is due, so Spearman contended, to the fact that the experimenters had "fallen into almost incredibly

[59] C. Spearman, *American Journal of Psychology* (1904), Vol. XV, pp. 201*ff*. By the objective determination of "intelligence" experimental psychology would appear, as Spearman thinks, "to be supplied with the missing link in its theoretical justification" (p. 206).

[60] Spearman reviews a long series of researches, from Galton (1883) to certain Columbia University studies (1902), attempting to establish a relation between tested capacities and general estimations of brightness and intelligence. Most of them came to a negative conclusion. "Laboratory and life seem to disagree upon the functional uniformities" (p. 219).

hurried and inadequate methods of testing" and to the "general non-existence of any adequate system for proving and measuring associative tendencies." From his own fairly meager experiments upon the discrimination of tones, lights, and weights, on the one hand, and from "expert" estimations of "intelligence" (school examinations and standing and teachers' and comrades' opinions), on the other, Spearman interprets his coefficients of correlation to mean that an exceedingly high correspondence exists between "general discrimination" and "general intelligence." He further concludes that "all branches of intellectual activity have in common one fundamental function (or group of functions); whereas the remaining or specific elements of the activity seem in every case to be wholly different from that in all the others." The following table adapted from Spearman (p. 276) indicates his correlations with "general intelligence," as well as the degrees to which various estimates and performances are, on his reckoning, "saturated with" or "functionally identical with" his common intellective factor:

	Correlation with General Intelligence	Ratio of common to specific factor
Classics	99	99 to 1
Common sense	98	96 to 4
Pitch discrimination	94	89 to 11
French	92	84 to 16
Cleverness	90	81 to 19
English	90	81 to 19
Mathematics	86	74 to 26
Music	70	49 to 51
Light discrimination	57	32 to 68
Weight discrimination	54	19 to 81

At a later time,[61] Spearman substituted for "general in-

[61] B. Hart and C. Spearman, *British Journal of Psychology* (1912), Vol. V, pp. 51*ff*.

telligence" the term "general factor" (or "general ability"), which enters into all "cognitive performances" and which he ventured to refer to the common fund of "intellective energy" which is accessible to the individual in every sort of non-mechanized performance. So regarded it would denote less a "function" in our sense of "mode" than the available energy of the organism and the economy of its use. Besides this common general factor, Spearman again allows "special abilities," each confined to a limited group of closely related performances. He is inclined to believe that the general factor appears in an approximately pure form in the "act" of discrimination. It is therefore virtually identical with a simple kind of perceptive apprehension carried on under a formulated task, the task of noting and reporting differences.[62] Whether the ability to functionate under this particular task has any peculiar relevance for "intelligence," we cannot—with the facts in hand—be certain. It is possible, of course, that Spearman might have come out with just as interesting and significant results had he employed some other form of instruction; though it should be remarked that the task of discriminating has been particularly useful wherever quantitative treatment of the reports has been desired. Witness the large literature on discriminative sensibility and the difference limen!

But Spearman's general factor is not everywhere accepted by statisticians. Thomson,[63] for example, contends that Spearman's hierarchical arrangement of correlations is traceable to his mathematical processes and does not necessarily imply a participation in a common cause or a "general ability." By way of disproof, Thomson demonstrated that

[62] Spearman was obviously impressed by Wundt's inclination to identify the central factor with attention. *Cf.* W. Wundt, *Grundzüge der physiologischen Psychologie* (1911), 6th ed., Vol III, pp. 596*f.*

[63] G. H. Thomson, *British Journal of Psychology* (1920), Vol. X, pp. 319*ff.*; *Biometrika* (1919), Vol XII, pp. 355*ff.*; Brown and Thomson, *The Essentials of Mental Measurement* (1921), pp. 164*ff.*

the "chance" drawing of playing cards and the "chance" throws of dice, from which—as he thought—a common factor was absent, led to a hierarchical order similar to that on which Spearman had based his contention. Thomson himself substitutes a "sampling theory" of "mental functions" which implies a large number of coöperating group factors varying from occasion to occasion and from individual to individual. The proposal is patterned after current theories of Mendelian inheritance. The theory is too general to advance, at least at the present, our empirical knowledge of those organic factors which underlie performance, attainment, and psychosomatic limit. Spearman maintains [64] in the face of criticism his belief in the argument from hierarchical order. He discovers a "latent" general factor in Thomson's dice hierarchies, and he concludes that the "fundamental theory" of two factors "has now been demonstrated with finality"; whereupon Thomson, who has of late (*Proceedings of the Royal Society*, London, 1919, A.95; *Biometrika*, 1919, Vol. XII, pp. 355*ff*) performed new dice experiments to refute Spearman's "proof," retorts that that proof "falls to the ground" (*Psychological Review*, 1920, Vol. XXVII, p. 189).

The proposal of other general factors, however (*e.g.*, "cleverness" and "purpose" by Garnett [65] and the "persistence of motives" by Webb,[66] as well as a fixed opposition to all general factors on the part of certain critics,[67] suggests that

---

[64] C. Spearman, *Psychological Review* (1920), Vol. XXVII, pp. 159*ff*.; *British Journal of Psychology* (1922-23), Vol. XIII, p. 267.

[65] J. C. M. Garnett, *British Journal of Psychology* 1919), Vol. IX, pp. 345*ff*.

[66] E. Webb, *Character and Intelligence*, etc. (Cambridge, 1915), pp. 51*ff*. Webb describes his "secondary general factor" as "consistency of action resulting from deliberate volition" and relates it to Ach's conception of will. His methods and his assumptions call for stringent criticism.

[67] Thorndike's position is that the "mental functions" are many, diverse, and generally unrelated. We have noted earlier that he confuses many kinds and categories in his list of "functions" (p. 331).

the method of mathematical inference from accomplishment to "mental function" has still to prove—if not its validity, at the least—its psychological significance.[68]

With respect to the psychologist's general anticipation from the *T*-methods, it is hardly fair to expect that, where those methods are overtly designed to pass "value judgments" upon "excellence" and "efficiency" and to procure diagnostic measures of output, they should at the same time enrich the descriptive account of the functional resources of the organism. What lies beyond the test, on the side of application, properly belongs to technology: what lies behind, on the side of description and analysis, seems to fall to psychology. The statistical methodology is, taken in itself, neutral. In the *P*-methods it has inclined toward the service of psychology: in the *T*-methods, toward the service of the technical arts of practice.

Comparison of the P-Methods and the T-Methods

We have observed that the same mathematical foundations underlie the two kinds of quantitative method proposed for measuring the limits of the psychosomatic functions. Both the *P*- and the *T*-methods are based upon the law of error and other similar uniformities of distribution in large numbers. Both propose to measure "magnitudes" and to state their results in the form of "probability." As we have seen, the *P*-methods derive their comparable measures from a large number of trials made under like conditions by a single

above). For his discussion of the "two-factor" theories, as well as of his own "levels" of sensitivity, association and dissociation or analysis, *see* his *Educational Psychology* (1913), Vol. II, pp. 332*ff.*; Vol. III, pp. 370*ff.* For an intermediate, "multi-factor" view compare H. Woodrow, *Brightness and Dullness in Children* (1919), pp. 229*ff.*

[68] Spearman's inclination to refer the general factor to some "hypothetical underlying force" or to a "common fund of energy" should remove the matter, at least for the present, from descriptive psychology.

trained and "instructed" observer; the *T*-methods from samples taken either from groups (as in the American Army tests [69]) or from a single individual, who is given a variety of different tasks (as in the original Binet). In the tests, the individual submits, without special training, to a task under which he is admonished to do his best. "His best" may be wholly undefined or it may be defined in terms of amount, economy of time, or accuracy. The means to be employed are grossly indicated by the setting of the task (the observation of pictures, the marking of pied letters, the "thinking up" of logical opposites, and so on); but there is no specification of functions to be exercised and no control of the various ways in which a facile organism may reach a given end. Of the three refinements essential to the *P*-methods only the third, the statistical, is present in the test. So far as administration is concerned, the test is similar, in principle, to the ordinary school and civil examination. In the treatment of the results, however, the test usually goes beyond the immediate accomplishment of the task to infer its diagnostic significance. Since the test is made under conditions which are not to be found in the scientific experiment, the crudeness of the score has to be relieved by statistical devices. This is doubtless the reason why the last few years of testing have brought a large number of mathematical refinements and "corrections," which are depended upon to make the results reliable and significant. It becomes more and more obvious that the results reflect quite as much the conditions of the occasion upon which the test is taken as the assumed "ability" or "efficiency" which the subject brings to his task. These *occasional conditions* are of a wide variety. They include the exact manner in which the test-material is laid before the examinee, the manner and the appearance of the examiner, the general organic state and the specific neural trends with which the subject meets his task, his previous

[69] C. S. Yoakum and R. M. Yerkes, *Army Mental Tests* (1920).

experience with similar tasks, his facility with the pen, emotional bias, the inclination to do well, the motives which tend toward, or away from, high accomplishment, and the facility with which the subject comprehends what he is to do and his aptitude for immediate absorption. All of the variable factors of the occasion, as well as the alternative psychosomatic resources with which the human worker generally approaches a set task, lie—at least as a rule—outside that "ability" or those "abilities" which the test is assumed to measure. Binet's method of surrounding the citadel of "intelligence" and shelling from every side may, by its very complexity, cancel certain of these factors against themselves; but it scarcely raises the exercise to the level of an experiment, in the meaning of the sciences. Whether statistical devices can be made to remedy the defects of the original collection of quantitative materials has not yet been shown. It is important, however, to remember that the final results of the *P*-methods and the *T*-methods are used for quite different purposes; and it may well be that the technological purposes of the administrator of the test will be best served by the means at hand. Unless we insist upon applying psychological criteria to the tests, it will be a misvaluation to judge them by the standards of the other methods. To prove the excellence of the pruning shears and the meat cleaver by a comparison with the instruments of the histologist and the surgeon would be, as Aristotle long ago intimated, to lose sight of the suitability of means as determined by their appropriate ends.[70] In spite of their common mathematical basis,

[70] The practical value of the "norm" or standard from which to measure deviation on the sides of defect and excess should not be minimized in estimating the *T*-methods. This value is at present indicated by the wide use of "intelligence quotient," "accomplishment quotient," "achievement quotient," "educational quotient," and the like, in current educational testing. The use of these terms will be conveniently found in W. S. Monroe, *An Introduction to the Theory of Educational Measurements* (1923), pp. 155*ff*.

the two types of method have until now occupied different fields.

It is possible that the careful and controlled reports of trained observers, made on the level of accuracy of the psychophysical metric methods and carried out under the guidance of some such schematic outline of the psychosomatic functions as we have found to be warranted by our present knowledge, might further the search for the fundamental modes of organic performance. Such an extended search would certainly—if the last quarter-century in the laboratories is significant—have to take into account the facts of *instruction* and of *Aufgabe*. There our distinctions of unpreparedness, *Einstellung* and formulated task, might serve a useful purpose. If the *T*-methods should, by their mathematical deductions, throw light in the future upon the nature of "intelligence" or of any other functional resource, that light will find enough darkness to dispel. It looks at present, however, as if their inclinations elsewhere would make them more useful in other directions. Whether high "correlations" run with like functions or with like *Aufgaben* or like *Einstellungen,* it is at present impossible to say. It is to be hoped that we will presently be able to pass beyond vague guesses about cerebral metabolism, synaptic resistance, reservoirs of energy, inherited capacity, and the like, to more empirical and systematic knowledge of the modes and the limits of the psychosomatic functions.[71]

---

[71] C. Spearman's recent book, *The Nature of "Intelligence" and the Principles of Cognition* (1923) makes a serious attempt at a descriptive analysis of the "intelligence" of the *T*-methods in terms of "cognition."

PART IV

THE SOCIALIZATION AND DEVELOPMENT OF THE PSYCHOLOGICAL ORGANISM

CHAPTER XVIII

SOCIALIZATION; ITS NATURE AND ITS FORMS

The Socialized Individual

Until now we have regarded the individual as independent of his fellows. But the organism is also social. It is social in the sense that it sustains relations with other like organisms. With these it lives in a "society." The human being grows up among others of its kind, constantly influenced by them, constantly taking them into account in its perceptions, actions, emotions and understanding; and constantly coöperating with them for the attainment of common ends. The psychologist's description of the organism and of its functions cannot, then, be regarded as complete until it includes the social, as well as the individual, aspects of experience. To these social aspects we now turn to provide our survey with the basis for a social psychology.

The most obvious way of beginning our account would be to assume the existence of a social mind or a "social consciousness." We might plausibly argue that since man is a social animal he must possess some special faculty which permits him to enjoy the fellowship of his kind and to sustain membership in his human institutions. These terms and others of the same tenor have obtained wide currency in our day; but to employ them and to build a social psychology out of them would lead us to forsake the methods of empirical science and to substitute hypothetical powers for the sober facts of experience.

Let us see whether we cannot avoid such hypotheses and instead derive our social psychology from the materials and

principles which have until now served our purposes. After all, we do not possess two minds; one for our own individual occupations and one to attach us to our fellow men. There is no mind that is social, whether conceived as the possession of the individual or as the possession of the group. Individuals may, to be sure, work and plan with a common intent, and they may be moved by like needs, like notions and like desires; but that is not to invest them (except by a loose figure of speech) with a "group mind" in which they severally participate.[1] We cannot so much as say that men respond to a "social stimulus"; for the only immediate antecedents to experience are, as we have seen, the physical agents, on the one hand, which set the receptors into function, and on the other hand, the nervous system with its trends and its predispositions.

One further caution! Socialization has often been made a synonym for association or mere propinquity. When we see ants in colonies, bees in swarms, cattle huddled under the shade trees, or men riding to business in a suburban train, we are prone to assume that they are socialized merely because they are together. That does not follow. The herd, the flock and the swarm are aggregates, but that does not necessarily imply sociality. It does not always imply sociality even when the herd feeds or wanders together or when the ants in the anthill go and come, heap up food and rear young. Sociality must be demonstrated, not assumed. You have yourself picked your way through accustomed streets, lost in a brown study, or listened with your fellow men to the music of a great organ utterly without socialization. And, on the other hand, the blushing animadversion to a tactless remark reviewed as you fall asleep makes it evident that one may be highly and violently socialized in complete physical

[1] One of the most recent of a long list of attempts to establish social psychology upon mental properties of the group is *The Group Mind,* written by W. McDougall (1920).

isolation from one's fellows. Association and massing may, it is true, be a *condition* of certain forms of sociality; but the two concepts must not be confused. Deegener has recently written a huge volume [2] which distinguishes scores of associative forms among animals; but only a very few of these forms suggest a problem to social psychology.

Our proper entrance to social psychology is through the psychosomatic functions. It is not mind which is socialized, but the functional operations of the organism. *Objects* are social, *events* are social, and so are our actions, our emotions, the topics of our understanding, and the problems which we elaborate in thinking. And we sustain relations with our fellows in the crowd, the audience, the throng, the church, the committee, and other like groups of human beings, only so far as we are able to give a socialized significance to the matters of life and to the affairs of the universe.

We must look first to the various means or processes of socialization, and after that to the human assemblages in which man exemplifies his social contacts and his social constructions. The most suitable approach to our facts is, then, neither through an unique social faculty or "social consciousness" nor through the associated group and its physical behavior. The behavior of the "herd" may be depicted and hypothetical springs of its performances—*e.g.*, such springs as "instincts"—may be invoked in explanation; but that is not to write a coherent psychology of the group and of its members. After all, the group is made up of individuals, and these individuals we must first know upon the social side if we are to understand the mass. The psychological problems of sociality, therefore, first demand a description of the individual member of the group and a

---

[2] P. Deegener, *Die Formen der Vergesellschaftung im Tierreiche*, Leipzig (1918). An informing account of the various "animal societies" will be found in M. Parmelee's *The Science of Human Behavior* (1917), pp. 390*ff*.

description, not in sociological or in biological terms, but in terms which are derived from psychology.

Socialization is Mediated by the Psychosomatic Functions.

Taking our great mind-body functions in order, we come first upon the varieties of apprehension to be found in perceiving, remembering, and imagining. The means of socializing the apprehensive functions are three; by way of the *shared object,* of the *possessed object,* and of the *observed person.* We share an object in perception by regarding it as "our" object. Thus the common dining table, with dishes and silver, includes in its significance reference to a common use. Not only are the appointments of the dining room perceived as objects arranged in a given order for the satisfaction of the needs of the individual user; they are also *our* dishes, *our* implements, and *our* household equipment. Furthermore, the perception may acquire symbolical meanings which tend to extend its socialization. Thus the appointments under scrutiny may stand for the generous or discriminating hostess, they may represent an intent to entertain, or they may be eloquent of the good wishes of an affectionate donor. So highly socialized are our homely surroundings that only the persistent and misanthropic recluse can hope to escape a constant extension of perceptive meanings to socialized reference. A more public form of the symbolic perception is represented by objects and events which signify the community, the church, and the nation. The trophy won by a competing team and displayed in the show windows of a store, the memorial windows of the church or the cathedral, and the national emblem are instances of this sort. Socialization in all these cases does not necessarily wait upon reminiscence or even for verbal description. Such objects as these include in their objective meaning the sort of reference which distinctly and immediately socializes them.

It is, as we may suppose, to these directly socialized objects that we should look for the beginnings of socialization among the other animals. The persistent notion that the animal can be socialized only when he is able to discern in his fellow creatures thoughts and feelings like his own, which he apprehends by a kind of introspective divination and sympathy, is obviously wrong. This notion is implied in Thorndike's paraphrase of the animals' "social consciousness" as their "consciousness of the feelings of their fellows" [3] and in his supposition that the idea of another's feeling suggests the power to transfer states felt in oneself to another and to realize them as existing there.

The second form of socialization of the perceptive functions is the possessive form. When I look at my recently acquired automobile or my spring clothing I socialize it in regarding it as mine. The belonging-to-me-ness in the perceptual meaning socializes the object. It socializes it even when it refers to no one else; for sociality refers as truly to one's self as to others. Finally perception may be socialized when the thing apprehended is a person. We realize this sort of socialization in every "social" introduction or presentation. Indeed, so highly are we tuned toward socialization of this sort that it is difficult to look upon or to hear a fellow being without this reference; and the rare cases where the social meaning is wanting (as in looking down from an airplane upon a busy thoroughfare or in jostling the objects depersonalized on the crowded sidewalks of the city) vividly instruct us concerning its import.

When we pass from the perceptive to the memorial and the imaginative forms of apprehension we do but extend and expand our socialization. By sharing and possessing past, future, and fictitious objects we at once make our social relations more inclusive and more enduring. Creatures which demand the actual presence of objects and persons in order to share, to possess, and to personalize are socially limited. We far exceed them in the richness and the significance of

[3] E. L. Thorndike, *Animal Intelligence* (1911), p. 146.

our social life. And it is especially with those recurrent objects and individuals which we socially regard day by day and year by year that we lay the firm and abiding basis for the complexer forms of sociality which attach us to relatives, friends, and acquaintances and to the permanently shared and possessed objects of daily contact and use. In the field of fiction and of make-believe, too, we consolidate—by way of the imaginational functions—persons and scenes of the novel and the unseen human performances conveyed to us through newspapers and books.

Going on to the executive functions, we find in action and emotion new and abundant resources for socialization. Consider, first, action. The basal means here lies in the shared action, the action whose verbal formulation runs "our action." The high social value of "executive" sharing has frequently been pointed out. The group-hunt, battle against a common foe, concerted labor, and the tribal dance were without doubt important means to primitive socialization. One theory—the yo-heigho-ho theory—of the origination of language contends, with some exaggeration, that the spontaneous exclamations and ejaculations under united effort, as in launching a boat or defending the tribe, suggested to man the first primitive words. In a similar way, group plays, gymnastic exercises, and the adventures of youthful scouts fulfill their socializing function among children, as do the more mature congregate actions in military evolutions and in athletic competitions among adults. A second actional form of importance is the sympathic form, the mimetic sharing of another's act. The socializing of the observer at the athletic contest and at the vaudeville theater rests in part upon this form of acting with another. It is as if the exertion of the ballplayer and of the conjurer were one's own performance. As regards the action, the onlooker and the performer are one. Here, without doubt, general bodily kinæsthesis, fused with the visual and auditory materials of

perception, serves a very useful purpose in that form of socialization which permits the individual to put himself in the place of another—a rare social virtue in all of us.

In advancing to the emotional varieties of the executive functions we shall discover still further means of socialization. First we consider the dance, which lies on the border line of action and emotion. The socializing function of this performance has often been remarked by students of primitive life. "The emotional plane of the dance," says Grosse, "fuses, so to say, the individual dancers into a single being which is incited and moved by a common feeling. During the dance, the participants enter a state of complete socialization. The dance compels and accustoms a number of individuals, at other times driven hither and thither by individual needs and desires, to adopt a single impulse and to move uniformly and synchronously toward a single common goal." [4] Grosse thinks that the hunting peoples themselves recognize this socializing function, for he finds that such tribes use the dance to strengthen the solidarity and amity of different groups or communities. But now the growth of societies beyond the feasible limits of the common dance has passed on to other agencies the social function of this primitive performance. Parades and like mass movements doubtless do their part in times of peace, and we all know how camp life, military operations and common dangers and suffering unite men in war, and how congregate operations and emotions in the patriotic mass meeting perform a similar function for noncombatant communities.

Taken as a class the emotions are widely and deeply socialized. Their predicaments are largely—at least in European and American societies—social predicaments. Either the predicament is shared, as in the terror of the earthquake and the grief of war, by a group, or else the situation which

---

[4] E. Grosse, *Die Anfänge der Kunst* (1894), p. 219.

leads to an emotive crisis is itself a social situation, as in jealousy, anger, and contempt. For we must not make the mistake of regarding all socialized emotions as shared. The solitary grief of the afflicted is every bit as socialized (since it involves a personal reference) as was the shared grief of the Trojan women. And such self-referring emotions as envy and jealousy strike the same high note of socialization as do the rage of the mob and the resentment of the protestant mass meeting. Although men are constantly oppressed by the struggle with inanimate nature, most of their typical emotions seem to be reserved for *social* predicaments. Of course, we must not confuse social unity and consolidation with socialization at large; for those predicaments which set us into antagonism or competition with our fellows are just as highly socialized as are the more comfortable emotions of understanding and amity. Here, as everywhere in psychology, we stop short of values, of praise and blame, and of goals and ideals, which may readily enter into sociology, ethics, æsthetics, and other like subjects, but which fall outside of scientific description. There is also a second side to emotive socialization. We commonly speak of "sensitive souls" where individuals catch the emotions of others and live them through by a sort of infection. Thus Browning's Sordello who sat with the laboring caryatids under the ponderous font, suffering with them in patient courage; thus the skillful actor identifying himself with a terrorized Macbeth; and thus also the responsive audience which receives from a dramatic presentation the necessary materials for reënacting the original tragic predicament.

Whether the actor is *really* seized by the emotion which he manages to convey to his auditors is the subject of a perennial debate. Two facts at least point to a fundamental psychological difference. The first is that the actor can, upon occasion, sharply terminate his assumed emotion. The second is that daily repetitions of a real emotion would seem to pass beyond the limits

of the organism. The training of the actor and the technical devices of his art, we may assume, supply a prompt and predetermined motor release which is not characteristc of the real predicamental emotion. It seems probable, therefore, that the chief resource in such dramatic performances is of the *actional* kind, with strong organic or sense feelings, rather than the complete emotion. This substitution really does not matter so long as the *emotional meaning* is sympathically conveyed to the audience.

This sympathic transfer is of enormous social significance. But its high social value does not call for the creation of an "instinct" of sympathy, the assumption of a "consciousness of kind" (Giddings) or the declaration of a non-specific innate tendency (McDougall).

In our general treatment of the functions of comprehension or understanding (Chapter xiv), we discovered the importance of the "topic." We perceive and we remember objects and events; but we understand topics. The words "weather," "railways," "politics," "punishment," and "labor" imply topics; and to get the meaning of them involves the exercise of the comprehending or understanding type of performance. Here we have only to observe that these topics are as readily socialized as objects, actions, and emotional situations are. The lecturer socializes his auditors, in part, by the matter which he discusses. The topics are *shared.* The auditor shares them with the speaker; but he may also share them with the other auditors. When the topic appears to the individual listener as "our topic" then it is socialized. This socialization may help or it may hinder the comprehending functions. Some persons understand best in the audience formation; others prefer to avoid the social implication. The dependence rests, we may assume, upon customary performance, the self-instruction of the auditor, and, possibly, upon deeper-lying human differences. Fragments of experimental evidence suggest wide individual differences; and it may be that work in hand in the laboratory will yield definite information upon the reasons for these disparities.

Besides sharing, socialization may also enter through those topics which themselves have a social content. Thus the topic of moral delinquency among university students or the topic of the income of men in a given profession may be distinctly socialized, though I consider it in physical isolation from my fellows. It is only necessary here, as elsewhere, that the *meaning* or the *reference* should be social. When we presently discuss the history of socialization in the human race we shall see that the social implication of topics, in the form of tradition and of constraint to understand and to believe as one's fellows do, has had a very great deal to do in molding human relations.

The elaborative functions are least socialized of all. As we observed in Chapter xv, thinking involves a problem. This problem the thinker must set for himself. No one can set it for him and no one can perform his essential functions of elaboration. It is natural, therefore, that when we set out to think, we tend to withdraw, to break our socializing ties, to dissolve our social meanings. There are, however, minor intrusions of social meanings upon our elaborative processes.

First we may "think together" in the give-and-take of discussion. What happens then—provided thinking does actually take place—is that means of solution, re-formations of the task, and critical rejections of faulty solutions are severally offered by the members of the "thinking" group. A more common "social" aid to thought problems is the introduction of part-solutions. This intervention comes most profitably after individuals have independently and privately expended their energies upon the problem. Thus the general discussion of public health or the critical consideration of scientific questions, by men of expert knowledge, may elucidate the problem, provided private thinking has already advanced it part way toward solution. In a sense, we do "share" thought problems; in the sense that matters of general concern to the state, the community, or the club—matters, then,

socially regarded—furnish materials for individual thinking. But that is not to say that there is actual "group thinking" by a "group mind."

We must not omit the social dissemination of the *products* of thinking. The great thinker bestows the fruits of his labor upon his kind. Philosophical systems, beliefs, new knowledge, in short, everything which the organism grinds out by way of its elaborative functions, may be socially employed. At times directly, as when students acquaint themselves in school and college with the thought of the original thinkers; at times indirectly, as when the philosophy of a Plato or a Descartes is translated into simple terms of common sense, and then imbibed in the form of tradition or of general belief. In this way a whole people may come to share in such a distinction as inert matter and energizing spirit or as reality set against mere appearance. Here and there such a traditional belief which has settled endemically upon men can be traced back to real thinking; though we must admit that the great mass of fixed and endemic beliefs suggests other origins. The tenacity of magic and superstition, when only a little thinking would soon break them up, leads us to suspect that fixed desires and authoritative creeds are much more potent in creating, as well as in preserving, the fixed opinions and the settled beliefs of mankind. Perhaps the spirit of the sciences, which encourages unbiased thinking, will in time have large social consequences; but even in this case the common demand is rather for the inventive outcome, in the shape of industrial speed and economy, than for the direct residues of scientific thought. Only within the last decades has America encouraged the systematic thinking of research and of scholarly production; and even now her chief concern is with such problems of the physical sciences as promise almost immediate inventive gains to the neglect of other scholarly forms of thinking—a state which has led many to believe that the cultivation of the elaborative

functions for their own sake and for the general enlargement of human vision rests among the arts of the distant future

The Conditions of Socialization

Until now we have considered the manner in which the individual is socialized. If he is not possessed of such resources as a "social consciousness," a "social sense," or a "group mind," then there would seem to be no empirical means to his socialization save those functional operations and processes which he executes with his total mind-body. These operations we have now surveyed, finding that they all contribute, each in its own way, to the socialization of man. We substitute, therefore, the socializing uses of these fundamental resources in place of more abstract or of purely hypothetical endowments.

But we still have to ask *why* we socialize. Why do we put social significances into "shared" objects and into gifts and into our observation of persons, into actions, emotions, and the rest? Why do we fear disapproval, seek the thrilling crowd, regard the sentimental letter as a bond between the sender and the recipient, run with the runner, suffer with the afflicted, and so on? It is obvious that these questions refer not to socialization itself, but to its antecedents and conditions. We might regard them as calling for a theory or explanation of the facts at hand.

Now no individual is socialized in a day or in a year. Whatever the conditions are, therefore, they must be operative over a long time. To find them, we should have to search throughout the lifetime of the individual and possibly throughout the history of the species. But this is a geneticist's quest and it will have to await the next following divisions, which seek to furnish a psychological account of the development of the individual and of the race. Here it will be sufficient to observe that the organism develops under four general conditions, conditions which underlie not only

its social development but its development taken quite generally. These four conditions are racial stock, exercise of function and growth, physico-chemical interchange with surroundings, and association with other organisms. Of course, we cannot regard the organism as adding these conditions together, one by one, and so making its way into and through life. It is really one fused product of them all which makes the individual what he is. The organism may be said (if we allow for the process of time) to *be* them. So that we must not look at these things as at a potter standing beside the living creature and fashioning it into what it is to become. They are, rather, *aspects* of life to be taken into account if we are to understand the persistence, the growth, and the functions of the organism.

To draw sociality from one aspect alone, whether racial endowment, habituated exercise, commerce with the physical environment, or association with others, is to distort the picture of life. Sociality develops under the common influence of all. It is only the emphasis of one or another that we observe as the kaleidoscope turns. At certain times certain functions of the organism largely depend, without doubt, upon racial predisposition. Thus the new-born mammal which "instinctively" stays close to the mother may presently discover its source of food; and this discovery will tend toward and encourage a primitive socialization of the perceptive and actional functions. But even here physical proximity plays its part and growth and interchange play theirs. In general, sociality comes to flower only when *all* the essential conditions of life are gradually and suitably supplied. The reference of sociality to instincts alone implies an adaptation of the "preformationist" theory, popular during the eighteenth century, which overlooks or minimizes all factors save the embryonic or the racial.[5] Another theoretical attempt

[5] A current example is W. McDougall's *An Introduction to Social Psychology,* (1921), 14th ed. It follows Ribot and James, stressing

to derive sociality and its products proceeds by invoking the "social medium" (our fourth factor). There the argument [6] rests heavily upon the interaction between the infant and the adult, with the consequent formation of habits, social and non-social. As Dewey states the case, "We need to know about the social conditions which have educated original activities into definite and significant dispositions before we can discuss the psychological element in society." Both views are certainly better than the assumption of a bare faculty of imitation (Tarde) or of suggestion (Ross); but each is partial. It is as if one observer sought to discover the single antecedent of a tree in the potentialities of the seed, another in the moisture supplied by the air, another in sunlight, and a fourth in the chemical ingredients of the soil. The social meanings and imports of perception, emotion, and the rest variously arise under many differing circumstances; and it is only when we take the past interaction of all the great conditions of life into account that we can hope to discover the growth and development of sociality. The details await a more nearly adequate genetic psychology than has yet been written.[7]

The Character and the Varieties of the Socialized Group

The word "social" suggests the crowd, the herd and the mob; and many studies have been directed to these groups and aggregates. It is obvious that this integrative side of sociality must some time receive attention. Any social psychology which should consider only the individual, leaving out of account the group, could not claim to be complete. But how is the group to be described? Not simply as a

---

in Darwinian fashion the close alliance of man and other animals and contending for "innate or inherited tendencies which are the essential springs or motive powers of all thought and action" (p. 20).

[6] J. Dewey, *Human Nature and Conduct; an Introduction to Social Psychology* (1922).

[7] The reader may return to the problem of origin and growth after reading the "genetic" sketch in the next chapter.

multiplicity of human beings bent on celebration or worship or destruction. That is not psychology. And again simply to depict the maneuvers or the behavior of the group will not suffice. It seems necessary to ask whether social formations have a *psychological* character and whether the various formations, as the crowd, the play group, and the public, can be distinguished by *psychological* criteria.

From the socialized individual to the socialized group, therefore, we now turn; and we seek first to distinguish the social formations among themselves. These formations are to be neither permanent institutions, the church, the state, marriage, and the like, nor such formal and logical organizations as the club and the secret society. These fixed structures are sociological, not psychological, formations. Our formations must represent fluid, active, and current relations among men; and it is only when these relations actually obtain, as in the chance meeting of friends, the surge of the crowd, and the throng of the city street, that the formations of which we are in search can be said to exist.

Although it is difficult to distinguish large and generic differences in the formations of our psychological kind, we shall find it convenient to set off the *congregate* from the *consociate*. As a rule, the congregate implies proximity. The audience, the throng, and the mob are congregates. The generalized social meaning of the congregate to the individual member is "we," or "we are together," or "we are members." On the other hand, the consociate implies, as a rule, the physical isolation of the individual, who is, nevertheless, invested with social meanings. When one suddenly sees one's name in the daily prints one enters the consociate. The generalized social meaning here is "I belong." It is a mistake, of course, to say that we are socialized only when we are in the mass. No one who has lived through a period of patriotic or religious fervor will fail to apprehend the variety of vivid experiences in solitude which make reference to the

fact that he "belongs." This consociate form of meaning arises much oftener than we are likely to suppose. The fact that mere propinquity or mere isolation is only conducive or incidental to sociality and is not sociality itself is shown (1) by non-sociality in the group, as when one becomes absorbed in a computation while walking upon the crowded street; (2) by the consociate moment of "belonging" which flashes into existence as one enters the door of one's club or church; and finally (3) by the vivid memory, as at a wakeful moment in the night, which places one again at a festive dance or in the theater. Even the direct apprehension of another individual, "impersonally regarded" as we say, may, on occasion, be devoid of social implications and meanings. It is possible, therefore, to divest oneself of sociality in the mass, to be consociated there, or finally to realize the congregate form of social meaning when the individual is "present" with others only in memory or imagination. Nevertheless, the congregates, which mean "we are members," *usually* appear where men are physically congregated, and the consociate meaning "I belong" *usually* arises when one regards oneself in isolation as sustaining a generic relation to one's fellows. The distinction we shall find to be useful for our description of the "group" side of sociality.

The Congregates

1. One of the loosest forms of congregation is the *casual throng,* which fills the crowded street and the deck of the ferry boat. It presents no shared topic, no object of common interest, no common action or emotion, and no unity of purpose. Socialization is here of the vague perceptive sort. Only a halo of social meaning, of "thronging," distinguishes the group from the non-socialized aggregate; and even this thread of conjunction may fail to bind certain of the "associated" but "solitary" individuals to the throng. A shade stronger is the congregate meaning of the throng when is-

suing from the church edifice or pressing together at the street corner where crossroads of traffic retard the movement and render the mass more compact. A still stronger bond unites that throng which pauses to inspect some neutral and non-social object, as an abandoned wagon in the street, a temporarily afflicted motor car, or a passing dirigible. Common inspection of the object is enough to amalgamate the human group. The neutral object commonly regarded comes to wear a social significance, which is then projected throughout the throng. If we replace the object by a human being, *e.g.*, the paper-woman whose stores are suddenly scattered by the wind or an unfortunate man sprawling upon the ice, the group becomes still more closely integrated. Here the perceived object is social in its own right and the occasion adds a shared emotion of pity or of mischievous pleasure.

2. From this variety, the throng-formation, we easily pass to the *audience*. Here enters the phenomenon of "polarization" which is characteristic of this mode of grouping. Socially regarded, the audience includes both "auditors" and "speaker." All are integrated into one group; but one member of the group occupies an unique position. He is, so to say, the "north pole." The first fundamental relation established is the all-to-one relation, the auditors representing and maintaining a common relation to the speaker. The poles are not interchangeable. The speaker has a specific social significance, a significance which we commonly emphasize by spatial isolation, by dais, desk, or pulpit, by special dress and deportment, and which we acknowledge by deference, quiet demeanor, and an expectant attitude. The correlative part of the audience is the one-to-all relation, assumed by the speaker. No one who has assumed this relation need be told that it is unique. Its first support lies in the perceptive functions. The auditors are seen and heard; and the seeing and hearing are charged with social meaning. How easily an emotional attitude also accrues, transforming the scene into

a "situation," apprehensive, fearful, or terrorizing, is well understood by the novice in public appearances. The marked difference between the all-to-one set of the auditors and the reciprocal one-to-all attitude of the speaker further serves to advance the process of polarization. But besides this establishment of reciprocal relations, the audience formation also includes an "all-to-all" moment of socialization. This moment is carried over from the last form of the throng, where the passers-by halted to observe the discomfiture of a fellow being. But in the audience the all-to-all socialization is richer. The bonds are closer and more significant. They are enriched, first, by convention and taboo. Certain proprieties govern all auditors. They sit "properly" and face the speaker. They refrain from speech and loud laughter. Their movements are restrained. They avoid giving offense. In this conventionalized attitude they immerse themselves in the common group. They become, so-to-say, insignificant "polar" bodies with a tacit cession of individualizing rights and prerogatives. This sudden functional change may be readily apprehended by any individual upon his tardy entry into a well formed audience or by passing casually from the outskirts to the "body" of an out-of-door congregation. Upon passing down the hushed aisle there is a distinct impression of being a stranger, half tolerated, until one is well settled into one's place. On the other hand, the ragged borders of an out-of-doors audience only half "belong." Here taboos and conventions are but weakly operative, and the hangers-on are apt to talk and to move about with freedom. Some persons find it distinctly unpleasant to merge themselves with the mass of auditors, while others seek without reflection the innermost or foremost seats. That this acceptance of "membership" under the all-to-all relation may seriously affect the *comprehending* functions of the individual has been shown by the distribution of grades in a university audience where the present writer lectured. The highest

average grades were attained near the center of the group, falling off in front, on both sides, and especially at the rear. This difference appeared also in both large and small audiences; hence it could not have arisen from the disabilities of distance and direction. It appeared also with other speakers and with a variety of university subjects.[8]

Now the precise temper of socialization in the audience depends both upon the polarized members, auditors and speaker, and upon the psychosomatic functions which are evoked. The expository speaker seeks to exercise his auditors on the side of understanding or comprehension. He therefore develops a topic. If the topic is itself social, *e.g.*, a discussion of human relations in crowded districts, it tends to socialize the audient group both internally and in its "sharing" attitude with the topic discussed. When the topic is non-social, *e.g.*, a classification of crystalline forms, the auditors tend to drop their socialization. Complete absorption in the topic may actually cancel the all-to-all relations and virtually establish a single one-to-one connection between the speaker and the audient individual. If, now, elaboration or hard thinking be engendered in the auditor, this one-to-one relation may itself disappear, leaving the hearer utterly non-socialized and isolated. The audience is, then, in a psychological sense, broken up and its membership dissolved.

Again the admission of emotions to the audience modifies in a striking way the social relations. Eloquence and oratory are designed to strengthen the all-to-one relations, sympathically uniting speaker and hearers; while dramatic portrayal is more particularly directed toward the emotional integration of the auditors among themselves. The substitution for the person of the speaker by some character or dramatic situation (as in the dramatic monologue) arouses in the auditors like feeling and a common predicament. The

---

[8] C. R. Griffith, "A Comment upon the Psychology of the Audience," *Psychological Monographs* (1921), Vol. XXX, No. 136, pp. 36-47.

shared emotion tends, even more strongly than the non-social forms, to remove the constraints of convention and taboo and to "free" the individual. Thus there enters into the audience a "crowdish" element which taints the pure audience-formation. We speak of the attendants upon a theatrical performance as an "audience"; but this group departs in significant ways from the typical audience which we have described. Polarity certainly is present. The footlights socially divide the total integration. Actors occupy the place recently held by the speaker. But within this pole new forms of socialization now enter. Here practically any socialized formation may appear; the throng, the audience, the crowd, the mob, the dialoguing pair, the deliberative group, or the emotively seized individual. Into these socialized groups the observers of the pit and the gallery sympathically enter. This grouping of a higher or secondary order is made possible by theatrical conventions and by the illusions of the stage. The "good" actor is the actor who forsakes the place of speaker in the ordinary audience and merges himself in the socialized group forming a unitary "north pole" upon the stage. A large part of the technique of the stage is directed toward the establishment and the maintenance throughout the play of this polar body. The unpleasant habit contracted by popular players of appearing for a curtain speech destroys this polarity of the group, inserting in an inartistic manner a temporary audience into the theater-formation. The appearance ministers, of course, to the social lusts of certain members of the mass-pole, who thus strive to satisfy, by a momentary all-to-one relation with the actor "as he really is," their craving for socialization with "the great." Only the cleverest of players is able to close this unwarranted breach in the main formation and to merge himself in the unitary polar mass during the final act of the play. It is obvious that the socialization of the total theater-group (embracing stage and auditors) is exceedingly complex, suggesting to the

social psychologist a large number of significant problems;[9] problems which are easily augmented by the addition of the cinema "audience," in which the perceptive and emotive functions carry the main burden of socialization. Here the substitution of the visual panorama for the mimicry of the stage profoundly affects the socialization of the onlooker, whose unpolarized submersion in the "action" of the plot is encouraged by the reduction of the all-to-all relations in the darkened chamber.

One further variant of the dramatic formation may be alluded to in the musical performance. Here we come upon many forms of socialization intermediate between the theatrical play at one extreme and the organ recital at the other. The opera is, in our regard, similar to the play; the chief difference is that music is added as a means to, and a medium for, socialization. Where the "personality" of the individual performer obtrudes, the relation lapses toward that of the audience. The all-to-one relations are likely to predominate, also, in the solo recital upon the piano or the violin or with the human voice. Here the social tempering largely depends, however, upon the training and the talents of the auditor. In the organ recital attended by persons of understanding, we seem to approach nearest to the lower limit of socialization. Contemplation of the musical object, to the neglect of the performer and of other auditors, tends to isolate, as by an æsthetic envelope, the intelligent hearer. The popularity of such forms of meeting suggests, however, their value to many as a social retreat into which the individual may withdraw to escape loneliness in a highly abstract and impersonal

[9] Such problems are (i) the all-to-all socialization of the actor-pole, (ii) the automatization of this group through rehearsal and convention, (iii) the sympathic sharing of the auditor in the topics and the emotions of the actors, (iv) the agencies for conveying socialized meanings from pole to pole, (v) false socialization of the players through mimicry, and (vi) the socialization of the player by the auditors.

form of consociation where he may, for the time being, safely and snugly "belong."

3. The *crowd* has so completely absorbed the attentions of many "social" writers, dictating at times a whole "social psychology," that we can afford to neglect it. Of high sociological value, in certain forms, and of great popular interest, it offers relatively little to the psychologist. Its main forms are two, the non-polarized and the executive-polarized. By removing the polarity of the audience, the group becomes "crowdish" and we then have the materials for a formation of the first type. A slight disturbance, as of a cat walking across the platform or a light flashed from place to place upon the ceiling, loosens the all-to-one bonds between auditors and speaker and inclines them toward crowdishness. Since these bonds sustain the taboos and the conventional restraints of the group, the crowd is inclined to be boisterous. Thus the likeness of the non-polarized crowd to the throng is close. A push from the outside upon a throng at the ticket window or the gate generates crowdishness. The throng apprehends itself as a group and the crowd adds to this apprehension an "attitude." The individual is either "with" or "against" the mass. A new shade of socialized meaning thus enters. The "with" and the "against" attitudes, carried by the members, are likely to lead to contrary actions; but the crowd is already integrated before the action appears.

The executively polarized crowd, in the second place, contains a leader. The speaker of the audience may remold the group into a crowd of this kind. The shift involves, first, an accentuation of the all-to-all relations and, secondly, the auditors' identification of themselves with the opposite pole. Thus a lecture ending in an exhortation to disturb a common enemy may form on the spot an executive crowd. The poles tend to disappear in the common action; but still the leader is set apart for a particular executive function. In this executive polarization he stands for initiative and responsibility. There-

upon a curious social change ensues. Having socialized the leader in this way, restraints, taboos and inhibitions drop from the mass. We speak of the crowd as socialized into a frenzy, when, as a matter of fact, the individuals in it are well-nigh unsocialized. It is this state of de-socialization which liberates deep and long-nourished tendencies leading on to excess. When the process is carried to its extreme limit we have the *mob*. Once the individual is released, polarity may entirely disappear, the leader being lost or forgotten and the mob sustaining itself by an old and absorbing hatred or by the sheer joy of congregate activity.

4. Related to the audience on another side are various formal "meetings" which depart in certain ways from our typical polarized congregate. The first of these variants is the formal *"executive" meeting*. Here a topic for discussion or business to be transacted takes the place of the speaker. The meeting proceeds under "rules of order." Usually a moderator or chairman is selected; but his main function is to propose the business of the meeting or to administer the rules. Polarity is, therefore, wanting or indistinct; though it may reappear from time to time when a member assumes the place of the speaker and temporarily organizes an audient formation. The priming of this group is less social than is that of the audience; respect for order and for impersonal rules taking the place of the socialized attitude toward the polar member. So constraint rests less upon taboo (which is likely to be highly socialized) and more upon expediency. The *deliberative meeting* is another variant of the audience. A consultation of judges and the deliberation of the jury are examples. The ideal here is an unpolarized state. The case to be adjudicated or the point of law to be decided unites the group. All-to-all relations are established. The more prominent the elaborative functions the looser these relations. The bullying of witnesses, the distortion of evidence, and the emotions of the court room, on the other hand, tend

rather toward a crowdish organization of the group when it finally forms. Again, natural differences among jurors tend to polarize in the form of the audience; the polar individual exerting, by virtue of his position, an undue influence upon the mass.

5. When we advance to the various forms of *play* we come upon social congregates of a different kind. But we must observe at the outset that the term "play" is not wholly specific. It includes many varieties and forms. For the greater part, it is the actional group of functions that is socialized, whether the play be a game, a sport, a drill, an exercise, or an "unorganized" form of activity. With play as separately regarded we are not concerned; but only with its socialized aspects. These are many. (1) One form of play exhibits a polarization similar to the audience. This is illustrated by formal exercise under a guide or model, who occupies the place of the speaker. The all-to-one relations are, however, simpler than in the audience and the all-to-all (mass) relations are loose and weak. Regular action governed and continued by the guide eliminates crowdishness. (2) A second form of play is unpolarized, the members sustaining neutral membership. Free systematic exercises fall here, and the "gamboling" play of the open field. Socialization is in part perceptive and in part actional. (3) When this sort of play becomes organized, that is to say, sustained by rules or a plan, we have an interesting modification of the polarized group. This is play with "rotational placement." The north or major pole rotates from member to member. In the parlance of the playground, one member after another is "it," the term indicating the social differentiation of function. Provision is commonly made for a frequent change of the member who is to occupy the focal place within the group. At times the rotation depends upon a progressive arrangement which grants to each member a "turn" in due order, as in informal ball games in the school yard; and at other times

selection depends upon skill, fleetness of foot, choice by the retiring occupant of the place, or mere chance. Much of the pleasure of the game is derived from this fixed polarization with frequent change of placement. It seems to exemplify a strong predilection among human beings for controlling the conditions under which a given person is allowed to occupy the focal point in a social formation. In the more serious plays, for example baseball, the development of a special skill may make it advisable that every position should be specific and be permanently occupied by one certain individual. Thus one man may be recognized the country over as a batsman or a pitcher. Here the mass would seem to disappear into a number of individual foci; but, as a matter of fact, in the dynamic progress of the game there is always a mass and always a focus, the scene and the players shifting with the play. Sheer skill and the joys of dexterous activity doubtless contribute much to the popularity of the game. That the game is highly socialized, however, at least to the onlookers, is apparent both from extemporaneous comments made during the play and from the reputation attained by the individual players. Nor must we overlook the socialization of a higher order uniting the grandstand and the field into a single polarized group. Here the tuning for carefree relaxation, the perceptual apprehension of the mass by itself, through visual, auditory, and olfactory means, and the sympathic fusion with the active players all contribute their respective shares to the social exhilaration of the game. The complexion of the performance changes somewhat in those *homo-polar* groups, like tennis, boxing and fencing, in which two individuals contend upon the same level. Here we have play in the "paired" form of congregate, which will occupy us in another connection. At times the like poles are composed of masses, instead of individuals, in the contention for supremacy. These masses may be homogeneous in function, as in the tug-of-war, or highly differentiated, as in football

or basketball. If we consider here the larger group which includes the "audience," we must again take into account also the congregate formed by the competing teams as well as the field-and-benches taken all together. In the latter, the "superior" congregate, we must note that the "playing" pole presents to the onlooking mass a split and rivalrous character, a curious social phenomenon which is prominent also in the baseball configuration just now described.

6. The *automatized and habituated* congregate deserves recognition among our typical formations. We observe it upon the parade ground and in the factory. The drill-group is sustained by rules, orders, and repetition. It is polarized. The commanding officer occupies the north pole. Though this individual may change, as the group passes from squad to company and from company to regimental formation, the social congregate maintains its character. Here is added to the characteristics of polarization the antithesis of authority and submission, an antithesis which tempers more of our congregates than we like to admit. As a socializing agency ("socializing" taken in the psychological sense!) it is extremely powerful. It closely unites the "mass" and strictly defines its relation to the opposite pole. In these habituated formations, whether military or industrial, socialization mainly touches the perceptive and the actional functions. Thinking, comprehension, memory, imagination, and emotion are well eliminated (except in a crisis) by automatization; and the former functions, too, may in time be worn threadbare, only leaving a vague consociate meaning "I belong," which is borne by a dull somæsthesis and a vague medley of sights and sounds.

We might expect to find unique facts of the congregate among permanent and formal organizations. But they offer a richer field for the sociologist and the economist than for the psychologist. We may, of course, trace their rise and their evolutional changes; we may also regard them as agents

in the formation of our temporary psychological groupings. On the descriptive side, however, we find the members of the state, the party, the church, or the secret organization constantly entering or emerging from one or another of the fluent congregates which we have described. We may content ourselves with the remark that the formal and the fixed human relations (the "organizations" and "institutions" as they are sometimes called) constantly *prime* the individual for specific forms of sociality. They are repositories of tradition, legal, moral, religious, political, etc.; and these traditions constantly force the individual to enter into socialized relations (not mere "associations") with his fellow men.

7. There remains one important form of congregate, a form almost wholly neglected by the student of social psychology. It is the *pair* which we touched upon in "play." Here a single type of relation is involved, the one-to-one type. We can scarcely doubt that this form of congregate, universal among men, has exerted a profound influence upon human affairs. The least intimate form of it appears in the common inspection by two persons of an object or occasion, such as the careless dropping of change at the ticket window or the slight deference shown at a narrow passage in a public place. Here the basis of socialization is likely to be perceptive. There is an acknowledgment of a "thou" and an "I." The difference between the pair and the mere inspection of an individual is that the paired relation is reciprocal. The formal "introduction" emphasizes this fact. To the isolated person moving only among acquaintances an introduction may be momentous; to the more sophisticated, casual and scarcely socialized. As a sign of new human commerce "social tradition" has been careful to surround the event with ceremony and rules of procedure. Thus, a third person is commonly required, who must be authentic, and who must carefully observe his forms, adapting them to the pair before him. The members are themselves supposed to speak, suitable

phrases being sometimes put into their mouths. Of a more complex nature is the sustained paired relationship of acquaintances, friends, and business associates. Here interests, duties, tastes, ambitions, beliefs, and common experiences indicate and diversify the congregate, which is carried beyond the perceptive level to embrace all of the psychosomatic functions and to involve a permanent set or inclination. An admixture of emotion and of sexual interdependence sometimes extends the paired relation, making it the strongest and, at times, the most durable of all the socialized forms. Out of this admixture may arise a fixed consociated meaning, "I belong" or "you belong," which is only relatively dependent upon the specific congregate or upon the presence of the second member of the pair. In the extension of the family the paired relationship is modified by other members. There a degree of polarity is certain to enter, one or both parents occupying a specific polar position, though at times new paired relations may appear, as between mother and son, father and daughter, or between two of the children.

The Consociate

Attention has been called to an aspect of sociality which is relatively independent of the specific group or congregate. This aspect is represented by the comment, acknowledgment, or conviction that the individual is adherent, in a social way, to "society"—either to society regarded at large or to a form or representative of it, such as the nation, the church, the university, the lodge, or, more indefinitely, the community. There is no factual evidence that this attitude, expressed in the statement "I belong," is constantly present in the individual's experience. It may be logically implied in "social creatures"; but it certainly is not psychologically existent at all times. Furthermore, it is accentuated in some individuals and weak in others; and now it is strong and again weak in a given person. Some of the obvious conditions which are

favorable to its appearance are guiltiness, imagined criticism directed to oneself, a suspicion of personal inferiority in some direction, a strong conceit, bad religious or domestic training, and popular emphasis upon the nation (as in war-time), the church (as in revival), or some other human institution. With so many reminders that the individual *belongs,* it is not necessary to assume a mysterious and innate "consciousness of kind" which should constantly instruct the individual in his obligations to "society." Neither is it difficult to understand why in certain unstable or oppressed individuals the conviction of "belonging" should rise to the heights of obsession.

The Products of Socialization

The creation of sociality and the formation of our temporary and fluent groups are of the first concern to the social psychologist. But they do not exhaust his problem. He has also to regard the permanent effects and products of socialization. These products fall into three classes. The first class includes customs, conventions, traditions, laws, usages, fashions, and social constraints. These lasting results of socialization rest as an endowment upon the community, tribe or nation. They may be set alongside such material products of human endeavor as cities, railways, power systems, and works of art, which men produce and leave behind them. Unlike those, however, the social products are immaterial. No one can see or handle a custom or a convention; although the thing is as real as a railroad or a sculptured column. It is an advised or prescribed way in which men act, feel, understand, and value. The social residues are human modes or "folkways."[10] Many of the more fixed and compelling of

[10] The term "folkway" has been given a somewhat different meaning by the late Professor Sumner in his *Folkways: a Study of the Sociological Importance of Usages, Manners, Customs, Mores and Morals* (1906), p. 2.

them collect about the serious aspects of life, about birth, marriage, death, and burial. There they appear as customary and ceremonial performances, as these serious issues of life have uniformly impressed mankind with their mystery and their solemnity. Magic, superstition, and religion have entered into the customary forms and observances which attend them. Ritual and rite are everywhere still to be found; and found often where their original significance has been lost and only the force of the original prescription retained.

The long and complicated history of these crystallizations into customs, usages, and the like has, for a generation and more, been assiduously studied in folklore, ethnology, and anthropology. While no existing group of human beings has been observed to be wanting in these precipitates of the process of socialization, the discovery of many forms, stages and kinds has shed light upon this aspect of the social life of man. It appears in general that when the individual members of a group have been loosely associated, as in nomadic and pastoral peoples, there the social impress is weak and there tradition flows in a thin line. Dense population, common enemies and complicated living, on the other hand, produce many prescriptions, highly socialized arrangements and ceremonies, and the heavy imposition of complicated folkways.

The second outcome of the fluent groupings appears in human *institutions*. Here we meet not only preferred ways but permanent organizations, tribal, national, religious, charitable, scientific, artistic, and so on. These institutions, of which the church and the political body are old and enduring examples, are usually defined by creeds, canons, or constitutions; and their existence is commonly defended by such means as rules, laws and punishments. Furthermore, they seek to sustain themselves by invoking the customary and the preferred modes of activity which fall under our

first class. These institutions are widely studied by the sociologist, the economist, the historian and the student of politics. Except as their nature and their history bear upon the processes of socialization, they stand about as far removed from psychology as architecture stands from the botanical and chemical origin of building materials.

The third outcome of socialization concerns its *effect upon the individual member* himself. Membership in any of our forms of congregate never leaves the individual unmodified. Here, again, the effects outlive the occasion. The individual gradually becomes socially molded and fashioned. Thus once more we are led in the direction of a genetic study which is reserved for another context; but here we must anticipate, in a general way, certain profound changes in the individual exercised by the constant contact with others in the typical groups which we have already briefly surveyed.

The first individual effect is a general disposition toward greater socialization. The isolated child wants the inclination, to be found in others, toward the establishment of those forms of social engagement which are satisfied by group-play, common study, and paired activities. Long confining illness at certain stages of development is said to have a like effect, and the simple life of the countryman in remote regions leads the individual to an ineptitude for social converse. Here we must advert to our earlier discussion of the various means for bringing into play the psychosomatic functions. We find no new excuse here for invoking a special "social sense" or an innate "social consciousness" to account for the observed fact that men naturally consort with their fellows. The inevitable result of repeated encounters is the establishment of fixed dispositions to charge events and occasions with social significance. Besides those purely neural preparations which we have called bodily predispositions we may find all the forms of "instruction" (formal, occasional, and self) leading the "socially tuned"

individual toward new formations. Here fall the expressed desires of our fellows that we meet, join, or coöperate with others (formal instruction), the association with others in the street, at home, and in the assemblage (occasional instruction), and, finally, the internal admonition to enter into play, conversation, or companionable relations (self instruction). From all directions we find ourselves inclined, then, by virtue of past congregate activities, to deepen, broaden, and extend our human relations. But, for the greater part, the organism comes to carry quite automatically the set for social meanings which arise as promptly and inevitably as the object meanings and the space-time setting of the present and the past. How far this socializing set would carry us, with the constant promptings of others, of the occasion and of one's self, I do not know. Probably a long way. But as a matter of fact we do not have to depend upon the organism alone. We live under what is frequently called "social tradition"; that is—to name it more specifically —under the constant influence of customary belief, fixed canons of performance and public opinion. These are the social products of our second class. Man is not wholly free to socialize himself out of his own personal give-and-take by mere habituation. Social formulas, plans, preferences, and rules constantly constrain him. The cumulative knowledge, superstition, and prejudice of his kind instruct him moment by moment, and day by day as to the way and the form which his socialization is to take. And as if these two sources were not sufficient the human institutions, inelastic because permanent, remain to be served and to be sustained by any individual who would hope to live at peace with his kind.

Conflict

Here enters the possibility of conflict or misadjustment. Were we progressively socialized under a constant "set"

alone, the process would promise a smoothly running and frictionless course. But the conditions are, as we see, much more complex. Process is constantly disturbed by product. As a result the incessant demands of our civil and domestic life, largely determined by traditions and by institutions, outrun the socializing resources of the organism. Hence arise misadjustments and conflicts. The individual fails to fit into this or that congregate or he may even, alas, fail to adjust himself to his social environment at large. These conflicts and misadjustments deserve a word of description.

Conflicts appear to us as of two general forms, "external" and "internal." The "external" conflict seems to concern one's relations to others, while in the "internal" kind one apprehends a disruption of an emotional nature with oneself. But both conflicts are really social, and moreover they generally appear in commingled form. On the one hand, "internal" conflict is practically certain to be reflected in the outside relations of the individual, and, on the other, outside demands, as they appear in moral and religious constraint, for example, are "internally" reflected in incompatible desires and tendencies within the individual. Commingling of the first sort is illustrated by the outside expression of lust, warring, and loss of self-respect. The parties to the conflict find it exceedingly difficult to settle their scores without external involvement. The individual may then seek to socialize himself emotively and actionally with "moral agencies" in the community, while the opposing appetites seek a different sort of company. Commingling of the second kind, where the outside relations strain the organism within, appears when constant parental reproach kindles a spirit of self-condemnation in the child, who then struggles vainly to attain his ambitions under the incubus of inferiority and weakness.

In truth, then, the conflicts are not of two separate kinds, one individual and internal, the other external and social.

All conflict on this level is social; for in its presence the individual apprehends his own warring impulses and desires in no less social a way than he apprehends his fellows and his adjustment to them. As the acutest stages in the process of socialization usually fall upon the immature organism, men look not unnaturally to childhood and youth as the main theater of conflict. Thus Dewey [11] reproaches the adult, with his traditions and his fixed formulas, for vexing the spontaneity and the natural impulses of childhood; and Cabell, setting the stage of conflict at a somewhat later time, declares that "youth vaunts windily, but in the end nobody can follow after his own thinking and his own desire. . . . Obligation follows obligation. . . . No champion can be stronger than everybody . . . in a world where all men are nourished by their beliefs." [12]

The psychological terms of conflict should not be confused with various logical and moral contrarieties about which much fruitless discussion has raged. In one form, conflict appears as the war of egoism (or self-love) against altruism; in another, as reason combating instinct, and, in still another, as the contention of the individual against society. Opposition of a sociological kind has lately been urged [13] in social psychology between the interests of classes and of institutions, of labor and capital, of business profit and the general welfare, and of men and women. With such oppositions as these psychology has little to do.

It is natural that the difficult process of socialization should have brought out signal differences among men with respect to conflict and to the effect of conflict upon the human constitution. Reference to our sections upon emotion will make

---

[11] J. Dewey, *Human Nature and Conduct* (1922), pp. 96*ff*.

[12] J. B. Cabell, *Figures of Earth; a Comedy of Appearances* (1921), p. 327.

[13] J. M. Williams, *Principles of Social Psychology, etc.* (1922). Williams seeks to derive the terms of these economic and domestic rivalries from such hypothetical instincts and native impulses as those by which Ribot and McDougall seek to depict the social animal.

it clear that conflict, as we are considering it, is characterized by a predicament and that it is therefore emotive in its nature. This helps us to understand its place in social psychology. It is of the essence of conflict that it regards those situations in which the self figures as *social* situations—social whether or not the reference is beyond the individual and to other persons. The very apprehension of the self is social, and when that apprehension presents a predicament, as of incompetency or sinfulness or undeserved insult, then we have the materials for conflict. For with the passing of judgment upon the self, in terms of social value, an issue is raised which demands, but does not immediately find, suitable means of resolution.

Stress and strain reveal structural weakness. It is not strange, therefore, that the student of defective and deficient organisms should have sought the causative factors in conflict. Clinical studies of mental aberration have revealed the serious effects of social stress. Socialized predicaments have been found to be connected with the origin of certain mental disorders and to stand related to pathological fears, obsessions, anxieties, and hysterical seizures. Thence has appeared, notably from Freud, Breuer, Janet, and their followers, an elaborate theory of the conflict as well as therapeutical means proposed for its alleviation. The adherents of Freud have come to regard the terms of conflict as set between desire or vital impulse (*libido*) and social restraint.[14] The immediate outcome of the conflict is, according to the theory which they have conceived, to suppress the desire and to confine it in the "unconscious" where it may become an irritant to the organism. Relief should come, as they think, by a kind of exorcism to be supplied through "psychoanalytic" treatment (p. 260). This doctrine, which regards conflict as a patho-

---

[14] Stated in gross terms, this means a natural antipathy between our first and fourth conditions of socialization, *i.e.*, stock *vs.* human association.

logical matter, raises the old assumption that socialization is inimical to the organism; that "society" is the sworn enemy of the "individual." But to look at the usual or customary form from the standpoint of the pathological is dangerous. In this instance the doctrine of conflict overlooks the fact that "society" not only allows the vast majority of its members to come to a healthy and useful maturity, but that it actually provides the means and the instruments of development and of education, permitting the individual to share in the fruits of its entire racial history. Conflict itself is not to be regarded as an unmixed evil. If it tries and tests the organism, so do the physical changes of dentition and of puberty. Conflict may indeed be regarded as a necessary series of incidents, sometimes fraught with danger, in the progressive socialization of the individual.

CHAPTER XIX

INDIVIDUAL DEVELOPMENT OF THE PSYCHOSOMATIC ORGANISM

The Psychologist's Use of "Development"

Life cannot be understood apart from its history. Organisms proceed from other, parental organisms. The body grows, develops, matures, and declines. Races, species, and genera likewise undergo progressive changes which extend over vast periods of time. This history, individual and racial, forms an important part of our knowledge of living beings. The study of the development of the individual is known to the biologist as "ontogeny"; that of the "race" or the total series of animals or plants as "phylogeny."

Now mental phenomena are, as we have had many occasions to observe, intimately associated with living organisms. They appear in the young—at least in many animals—and continue throughout life. This attachment to the processes of life raises the presumption that mind, too, may have a history, both an individual and a racial history. The terms for its consideration are at hand in such phrases as "mental development," "the growth of mind," "the mental evolution of animals," and the like. We are led, therefore, to supplement our other views of experience by an inquiry into its genesis and development. First we shall consider progressive changes in the human individual and after that the general, evolutional side of development in the whole animal series.

Our first task is to give a brief indication of the development, within the growing individual, of those qualities and

integrations of experience and of those psychosomatic functions which determine the psychologist's account of the organism.

We all know, in a general way, what we mean by the development of the infant into the child and of the child into the adult. Bodily growth, characteristic changes in appearance and performance, an increase in capability, in knowledge, and in skill, and a maturing sophistication doubtless enter—all of them—into our conception. But this composite character of development suggests that our conception is itself mixed; that it includes at once the notions of extension (in size and capacity), of qualitative modification (the maturing of the figure and the "putting away of childish things"), and of improvement (attainment of skill, of "efficiency," and the like). Before we psychologize development, therefore, it will be well to clarify the essential notion of genetic change.

First of all we must eliminate the element of value, in the sense of "improvement." That element is proper to the view of the teacher, the parent, and the ethical guide, whose aim it is to uprear, to direct the young toward adulthood as toward a distant goal. In that sense, development spells progress, advancement toward an end, and hence improvement. This view is automatically taken by those institutions and those agencies which assume the responsibility of bringing the child from a less perfect to a more perfect state. But it is not the attitude of the sciences, which seek to describe and to explain but not to set values or to classify in terms of worth. This distinction could easily be made in determining a genetic scale for fishes or for birds. There such considerations of "value" as market price, swiftness, or symmetry of form do not enter. But it is not so easy in describing human development, where society takes the responsibility of "advancing" the child toward the estate of the man.

Can we leave this ethical and educational element of "im-

provement" or "advancement" out of our genetic account? Let us try. We shall, then, first of all regard experience just as we have in our other sections; save that now we shall look for such continuous and gradual changes as the anatomist or the embryologist would seek in describing the development of the body. If we succeed there, we may go on, as other genetical studies would, to discover the *conditions* which underlie development.

The Development of Qualitative Variety in Experience

It is obvious that the acquirement of qualitative variety in experience is not the most essential aspect of mental development. So far as receptors go, and so far as the foundations of nervous architecture go, the organism is functionable soon after birth.[1] Eyes and ears, tactual, gustatory, and olfactory organs are soon ready for stimulus; and when we leave out of account the knowledge which we gradually attain to and the vast variety in the world which we come ultimately to recognize, we have no reason to doubt that most of this qualitative variety of experience itself is already in existence, though its uses in perception, memory, understanding, and thought are still unrealized. Nor should we think of an "idling" mind, not yet thrown into commission, which exists as a "blooming, buzzing confusion." As sensibly might we ascribe confusion to the planets because they failed to grasp the uniformities in their orbital movements. Some of the sensational qualities, notably those derived from the visceral and the dermal receptors, exist before birth; though there is no reason to believe that they contribute to a perception either of the body or of its surroundings.[2]

---

[1] It has been assumed that medullation of the neuronal processes, not wholly complete at birth, is necessary to receptor and to central functions. The functional relation involved is not wholly clear. *Cf.* P. Flechsig, *Gehirn und Seele* (1895); J. B. Watson, *Animal Education, etc.* (1903).

[2] One of the extravagances of psychoanalysis is the contention that

Whether the qualitative shading which we recognize in ourselves as existing between the sensational and the sens-imaginal processes is present from birth we do not know. Since the difference rests, however, upon central functions in the presence or absence of stimulus and receptor, we might suppose that it appears as soon as the structurally complete nervous system has been thrown into commission. It may await, however, devices of inhibition which are wrought out much later. We must not confuse this ultimate qualitative duality, in any event, with such matters of *operation* as perception, memory, and imagination. The fundamental processes of metabolism, necessary to the maintenance of life, with their shifts and turns and balances, would seem to leave no doubt of the early existence (before as well as after birth) of the affective qualities of pleasantness and unpleasantness. The total trend of experience thus affectively colored is, of course, vastly different in the infant and in the adult; and so also is the range of those conditions (emotional, æsthetic, perceptive, etc.), which enter at different periods of development. But those are both matters of another order.

The Development of Integration and of Psychosomatic Function

Now we find ourselves at the fount and origin of those sequent changes in the individual which imply the growth

---

prenatal perceptions of this character persist in the "unconscious" to afflict the individual in his mature years. This is a clear instance of the "psychoanalyst's fallacy," which confounds the speculations of the adult with supposed experiences of the unborn. This fallacy naturally leads on to an undue sophistication of the young child. *Some Contributions to Child Psychology* (M. Drummond, 1923) contains an appalling modern instance. During the first three months the child is said to be "doing hard intellectual work . . . in making an intelligible world out of his confused and contributory sense experience. . . . Crying fits may arise from pure intellectual fatigue" (p. 3).

and development of experience. It is obvious that the major changes take place here rather than in the ultimate qualitative variety of experiential "processes," which are, so to say, given with the organism in its uterine and free life. First, we consider the integration of qualities.

Those who look upon primitive experience as the confusion of unassembled and unadjusted parts (the chaos theory) would leave the entire problem of mental organization to be worked out in the individual's career. But this view leaves out of account the fact that the organism is not only structurally "assembled" from the instant of fertilization (earlier, indeed!) but also functionally organized and operative. It is true that the human organism does not at once become a perceiver, a resolver, and a thinker; but those psychosomatic functions, gradually acquired, are not to be confused with the architectural structures and configurations of infantile experience itself. For the nature and extent of these early patterns we have to look to stimulus, to receptor, to central organization, and to the character of those typical situations into which life casts the infant. But to read the significance of these conditions, we must, of course, advert to the corresponding facts of adult organization which are better and more directly known (Chapters iv to vii).

The most obvious of the primitive organizations are those arising under simultaneous stimuli. Here we find, in adult experience, the qualitative and extensive incorporations. Again we must not confuse the bare patterning of qualities with the apprehension of objects and events which the individual comes gradually to compass. As regards the former, the presence of differentiated receptors, the concomitant impress of stimuli, and the integrity of the nervous system would seem to guarantee all the necessary conditions for those simple groupings. What the early, pre-perceptive and pre-memorial experiences are psychologists are just now coming to understand from a first-hand inspection in themselves of

film-colors, surface-colors, simple tonal relationships, *Anschauungsbilder,*[3] primitive visual movement, and undifferentiated spaces.

It is very difficult to generalize from the fragmentary evidence; but we have reason to believe that before the individual has worked out, and so created for himself, a world of fixed spatial and temporal forms, of ordered objects and related persons, of ideas and ideals, of likes and dislikes, his experience already includes regular patterns and configurations which are not yet built into a perceptual and ideational world.

Most observations made upon the child himself are so distorted by notions of advancement, education, training, and proficiency that it is difficult to discern their true *psychological* meaning. When we regard only the patterns of experience, using all the information, anatomical, physiological, and psychological, at our command, we are led to regard these patterns as relatively few and diffuse, as chiefly made up of gustatory, olfactory, and somæsthetic qualities (visual and auditory structures being less numerous and less frequent), and as presenting fewer marks of emphasis and clearness than later experience.

It has been suggested [4] that the first bit of experience consisted in setting one quality against a homogeneous and undifferentiated background, as the warm pressure of sucking against an undisturbed "organic" diffuseness. This view finds the essence of experience to lie in the double fore-

---

[3] E. R. Jaensch has lately maintained that the common ancestor of the configurations of perception and of idea (or image) is the original image of apprehension (*Anschauungsbild*) which he discovers in many children before the advent of puberty. (*Zeitschrift für Psychologie,* Vols. LXXXIV to XCII; *Zeitschrift für Sinnesphysiologie* (1923), Vol. LV, pp. 47-132).

[4] K. Koffka, *Die Grundlage der psychischen Entwicklung; eine Einführung in die Kinderpsychologie* (1921), pp. 89-101. Koffka here applies the theory of the *Gestalt* to genetical problems.

ground-background "structure," forming a unitary whole and leading on through development to more and more complex forms. It places greater emphasis upon assumed *central* conditions of the early formations and less than we have upon the part played by diverse and graded stimuli and receptor-functions. If we reduce the clearness of primitive qualities to a very low degree, except where some inherited device tends to emphasize one factor only (the tactual and kinæsthetic part of sucking, the breast-odor or the face of the mother), which then stands out in distinctly higher clearness, we come to practically the same thing. Taking the usual events of early infantile life into consideration, we find the first well-defined "foreground" patterns in the events of food-taking and its digestive sequels. The consolidation of function under repetition would lead to a gradual strengthening of these patterns; and the relative reduction of the periods of sleep, after the first weeks, would certainly increase the visual and auditory aggregates both in their range and their complexity.

As for the psychosomatic functions first operative in the early weeks, we find no evidence of a fixed and orderly perception of persons, objects, and events, such as would be involved in the apprehension of the size, distance, shape, and solidity of objects, or the recognition of persons as belonging in a given "place" or with a given context. Spatial meanings and contexts doubtless grow, as most psychologists have contended, along with the simpler executive functions of the reflexive, impulsive and random sorts. The organism is not a blank tablet awaiting impression. It is the seat of exigent needs and of restless activity. This fact gives to experience a transient, forwarding-tending character, binding together the earlier and later, the pressing need and its satisfaction, a given trend and its immediate successor, all informing experience with growing significance and meaning. Early experience is rich, kaleidoscopic, and connected long before any-

thing like our own sophisticated perception. During the early weeks action, too, would be unlike our own forms, which are either highly automatized, through frequent repetition, or else bound up with a perception of the self and of its physical and social relations. Instead, the initiation of movement from the central nervous system and from the viscera early produces an abundance of muscle-strain complexes; and the thrust of needs on their way to fulfillment supplies a rich background of organic "coloring."

An extremely important moment in psychological development is derived from the intimate fusion of perception and action. This fusion is strikingly presented in puzzling situations in which the child or other animal seeks a deferred and difficult outcome. The dog or cat in the puzzle box or the child seeking to "find" an object before eye and hand are coördinated gives us the setting for this functional fusion. The older explanations, which sought to describe these performances in terms of "associated sensations," calling them instances of trial-and-error, failed to see the import of the functional fusion. Exponents of the *Gestalt* have clarified the matter by insisting that, in the case of the dog or the cat inclosed in the puzzle box, the escaping-devices, the movements of the restless animal, and the escape-to-food are all bound up into one single organic function which proceeds toward an end-result or outcome. This is an early form of what we may call "executive search." Into the course of this function, which is at first represented on the "object" side of experience by a vague and almost meaningless apprehension of the animal's surroundings, comes in time a luminous and significant meaning. The "object" may be the catch releasing the door or a dangling string which opens a trap in the bottom of the box. It becomes an *apprehended* object only when it is related to "escape-and-fôod" and its meaning is "thing-on-the-way-to-food." How undefined at first its own qualities are is beautifully shown by the possi-

bility of replacing it by a larger catch or a different string or by placing the critical object in another part of the puzzle box. Just so long as it remains "that thing," meaning "escape-and-food," it continues to functionate in the animal's behavior. Repetition serves to define and to extend this meaning, including qualities of the object itself, and the action of the animal varies accordingly, growing more precise and more dextrous as this "middle-point" in the psychosomatic function gains in clarity and in consolidation with the whole unitary performance.[5] When this focal point fails to appear the entire function remains amorphous and the animal fails to "learn" to turn the trick and so to escape.[6] But it appears from the experimental evidence that when the critical object is sufficiently apprehended and incorporated into the total function to lead on to escape-and-food, a permanent gain for development results, a gain which seems to lead, in like subsequent situations, to a quicker and more significant apprehension and hence to facilitated "learning." We must now discover more about these gainful residues of primitive performance.

Habituation

We cannot adequately conceive the development of early experience upon the side of operation until we take into ac-

---

[5] That a single attribute of the object(say, color) may serve to incorporate the middle-point into the total function was shown by the author's use of the color red as a signal for food in training a fresh-water fish. Size, form, and place of the red object seemed to play no part; "that-redness" alone entered into the feeding performance. *See* Washburn and Bentley, "The establishment of an association involving color-discrimination in the Creek Chub, Semotilus atromaculatus," *Journal of Comparative Neurology and Psychology* (1906), Vol. XVI, pp. 113-125.

[6] The theoretical setting of the event in terms of *Gestalt* we need not adopt. For us the description is purely functional, in the psychosomatic sense, and not an account of the new phenomenal *Strukturen* whose creation is maintained in the terms of this interesting theory.

count the cumulative nature of neural function. Those complex events of the organism (*e.g.*, feeding and playing) which bring in the receptors, the muscles and the glands, the central nervous system and the qualitative patterns of experience, do not run their course in single file and then desist, leaving the organism as they found it. Function reacts upon itself, profoundly modifying its subsequent exercise. Were this cumulative effect absent, experience would be like the successive and separate display of characters upon the paper as the carriage of the typewriter is shifted. There each character takes its place upon the line without modifying or influencing its neighbors. But in the functions of the organism the earlier terms affect the later, changing their nature and modifying their significance.

We have found (p. 181) a simple form of this modification in the "conditioned reflex." Here a movement or a glandular secretion,[7] which was originally set off by a highly specific stimulus (as the hammer tap for the knee-jerk or food in the mouth for the salivary reflex), may come to be released by some other stimulus (as a sound or a light) which has repeatedly been given with the *original* stimulus. This substitution of a new initial member in a series of neural activities seems to be but a special case of a very general principle in the functioning of the nervous system and its organic associates. We may express this principle by observing that an organized neural function tends to incorporate within itself outside factors which are frequently given simultaneously with it. The principle (*cf.* Chapter vii) is of great importance in mental development. Watson [8] has clearly shown how emotional situations are greatly

[7] Careful observers generally agree that much of the early random movement of the child is internally or centrally initiated. *See* Koffka, *Die Grundlagen der psychischen Entwicklung*, etc. (1921), pp. 47*ff*.

[8] J. B. Watson, *Psychology from the Standpoint of a Behaviorist* (1919), pp. 199*ff*.

enlarged in childhood by attaching to old fears new and neutral situations, which then become as fearful as the old. But this principle has still wider applications. It means that development is, in large measure, a psychosomatic enlargement and modification which derives from repetition with new elements. Thus in perception the object is constantly enriched by new settings and new positions; the perceived event by modifications in its course. In action, like motives and like movements are evoked by the substitution of one occasion for another, the like performance engendering the same or a related meaning for all the occasions. In memory, a rehearsal incorporates novel features, thus aiding retention and defining the memorial reference. The general effect of this sweeping in of new factors and new occasions under old functional rubrics is to extend and to expand all performances of the mind-body.

But repetition casts out as well as drags in. Such a laborious action-train as the early attempts at writing is simplified and "mechanized" under repetition. Unnecessary factors are eliminated. Here perceptive meanings and actional motives are reduced; but, on the other hand, the functional output for the organism is greatly increased. This is the way toward the acquirement of skill. Putting together enrichment and extension, by way of new incorporation, and the selective processes of elimination, as the neural function is repeated over and over, we have the essential conditions of *habituation,* which is readily seen to be a cardinal factor in the development of the psychosomatic functions.

But the reader may well ask whether "instinct" is not to be added to "habituation" as of coördinate significance in the development of the individual. Does not instinct, once and for all, endow the individual very much as habituation gradually equips him? We shall be wise if we substitute for "instinct" (which generally stands for innately prepared actions of a specific and complex type) the total organism

with which we began our genetic survey. The racial history is deeply written upon this organism and it remains as one of the primary conditions, not only of action but of *all* the functions, somatic as well as psychosomatic, which the organism is to acquire. Just as we counted "stock" among the four primary factors whose product molds human sociality (p. 467), so in individual development at large the factor of stock, represented by the morphologically and functionally prepared organism, must be reckoned in. We have, of course, already considered it in acknowledging the debt of development to nervous system, receptors, muscles and the rest of the structural equipment. There remains now only the question whether stock also provides specific functions of the psychosome which play their own essential rôle in development. Those who derive the greater part of "human nature" from native capacities and innate powers tend to exaggerate "the instincts." Consider briefly our main types of function and see how the case stands. First among the apprehensive group stands perception. Apart from the selectiveness of pattern determined by receptors, natural stimulus-complexes (*e.g.*, mixed daylight, vibration-ratios in sound, "taste" complexes) and the integral nervous system, we find little or no evidence that human perceptions are "natively" or "instinctively" determined. The case is still plainer for memory and imagination. Comprehension and thinking are much later products of individual experience; though no one would deny that aptitude or cleverness here may go down to a racial root. We are thus left with action and emotion, the two closely related types of executive function. Here a racial "preference" is clearly seen. We have at least the reflex mechanisms and their simpler trains, some of which do not stand in need of tuition for their prompt release. These are, of course, the forms of bodily movement which stand farthest removed from experience and, in their origin, from the psychosomatic operations. Although extremely use-

ful in the maintenance of life, they do not, in their pure form, greatly enrich experience on the side of qualitative variety. As for the more complex forms of early movement (the "instinctive actions") the case is somewhat different. When we allow for all those "conditioned" actions which are not true instincts and for the reflexes, not much is left. What is left seems to be (1) a few racially-determined sequences in function, such as sucking, grasping, manipulative and defensive movements, and varied movements of the head, body and legs;[9] and (2) a tuning of the organism in accordance with an abiding want or need (as hunger or sex-excitement) which, so far as it appears in experience itself, represents the indicatory rather than the patterned side.

But if we cannot grant so large a place to the "instincts" as many picturesque writers do, we must, on the other hand, insist that *whatever* the organism does it does as its lineal and racial history has prepared it to do and that, in so far, the historical factor is *always* involved in the functional product.

Learning

Our own interest in learning rests, not on its results, which are improvement, "capacity," and acquisition (matters of high educational and social importance), but on the immediate changes in function which the individual undergoes during development. Human and educational inquiries into the growth of children have provided a large amount of factual and speculative material upon the progressive and changing interests, accomplishments and acquisitions of the child. At times this progress has been taken to *be* mental development and again to be evidence that development has taken place. But of development itself and of its uniformi-

[9] M. G. Blanton, *Psychological Review* (1917), Vol. XXIV, pp. 456-483. *Cf.* Watson's *Psychology from the Standpoint of a Behaviorist* (1919), pp. 254*ff*., and Koffka's *Die Grundlagen der psychischen Entwicklung*, etc. (1921), pp. 78*ff*, for sensible accounts of the instincts.

ties or "laws" we find, among these inquiries, relatively little.

If our account of the psychosomatic functions is reasonably accurate and complete, then the development of the individual will be mainly a progressive extension and enrichment of these functions and of their antecedents. A great deal of that which we commonly regard as development consists in finding new occasions upon which the organism may exercise its old capabilities. Thus the infant whose early perceptions and actions are exceedingly limited comes, by way of such new occasions, to an apprehension of attendants, furnishings, and moving things, to the manipulation of toys and other near-by objects. We say that he has "developed" in acquiring new "interests," more "knowledge," and greater "skill." The fact is that the same apprehensive and executive functions have been exercised on an increasing number of occasions and in new situations. What underlies this extension?

Consider first the separate contributions made to these functional performances by the body and by mental factors. The body furnishes the vehicle and the energy. Mental contributions are meaning or reference and an indication of vital state and change. As we have seen, on neither side is the human organism prepared at birth to initiate these psychosomatic functions in any variety. We have only an obscure forecast of perception and of action. In preparation for emotion we have variously shaded organic states (chiefly digestive) which need only the advent of the predicament. This term is soon supplied (chiefly through human agencies) by the thwarting and inhibition of needs. The vehicle is virtually complete on the structural side. Energy is present in abundance. While a great deal of it is expended in random and loosely coördinated movements, some of it (as we have seen) is governed by natively determined functions, chiefly such as minister to the maintenance of

life (breathing, sneezing, crying, feeding, and defending). Watson is undoubtedly correct in his belief that these incipient activities suffer their first extension by the process of simple "conditioning" (repetition with novel elements). We should not agree with him, however, in carrying the first emotions (he discovers three) back to a native or "instinctive" base. The primary effect of this conditioning is to integrate more complex neural and muscular activities and to create new meanings, perceptual and executive.

But there is a second avenue of development which is quite as important as the direct extension and new organization of experience. This effect is wrought upon the *antecedents* of functions. These antecedents are, as we have seen, (pp. 387*ff*), either neural alone (predispositions) or psychosomatic (instructions). After a functional operation, that is to say, the organism is left "disposed." The disposition may be a general tuning, as shown in alertness, expectancy and reluctance, or it may take a specific form which enables the organism to "settle into" a repeated performance with ease and facility. These preparations for function take a great number of directions and they have quite as much to do with development as have the typical functions themselves. One of the earliest forms of preparation is of the rhythmical or periodic kind. Punctual feeding, bathing, and sleeping soon induce a readiness for repetition. The organism is functionally charged as the period approaches. The common injunction to observe these periodicities in young infants considers not only the digestive and hygienic effects, but also the emotional bearings of a regular régime. Unfulfilled anticipations of the organism lead to crises and predicaments which easily sweep in any adventitious circumstance such as locality, bodily posture, or the approach of parent or nurse and which may seriously disturb natural development. Presently the preparation for function passes to one of the forms of instruction. The *occasional* form appears first. A sound or a

"visual" object may introduce a given function. Thus a familiar voice may engender an emotion or action or prepare the organism for a particular perception. But the responsible attendant of the infant is likely to lay most stress upon the second or *formal* kind of instruction. This naturally takes the commanding or prohibitive type, seeking to govern the infantile functions by an authoritative "come," "look," "take this," "don't," or "mustn't." After a time these formal instructions become highly socialized and are foreshortened to hints, nods, facial expressions, and mere divinations of the wish or desire of some other person. In more advanced life they become abstract and generalized in the form of "public opinion" and of "that which is expected of me." In the third place, there arises for the initiation and the government of these functions the *self-instruction*. This determiner seems to be rooted in craving and its successor, desire. Just what form the self-object first takes in infantile experience is not known; but we may be reasonably sure that it appears in the apprehensive functions in connection with the fulfillment and the thwarting of bodily needs. There is no reason to believe that it involves at first a careful delimitation of the bodily members. But the character of early experience, especially in its emotional moments, would lead us to suppose that self-instruction soon acquires a vague socialization which is of great import to further development.

All forms of instruction become gradually more varied and more abstract as a result of antecedent experiences. Such forms of self-instruction as "I must try repeatedly," "I shall carefully scrutinize this object," "This action will injure me" imply a wide differentiation of the functions which are immediately to follow, as well as a more or less permanent effect upon subsequent experiences. With the advent of language (itself due to the apprehensive and the actional functions) all the forms of instruction are enormously increased and the exercise of the resulting functions

vastly extended. The child's resort to the inquisition concerning objects and their origin is one obvious use of language, and another is the extension, through words, of self, occasional and formal instructions. The latter use prominently appears in the early school years when perception and action are enriched through the verbal guidance of the teacher; and the ability to initiate a function by the preparation expressed in the words "I am to add those," "Here I must divide," "The lesson includes these pages," "This piece will fit in here," and the like, implies a wide extension of the range of experience. A good deal of what we call "committing to memory" falls—so far as it is psychological—under the repetition of a function which is kept going by a persistent self-instruction. These persisting instructions also serve development by keeping the organism engaged while modifications under habituation and practice are taking place.

To describe the order of development of the several functions and of their preliminary dispositions (neural and psychosomatic) would lead to more detail than we can here afford. In general, we can say that the perceptive, actional and emotive functions, operating under relatively simple and concrete dispositions, come first and that their early socialization and the advent of language rapidly lead to a wide amplification. Memorial and imaginative extensions of perception probably appear slowly and sporadically. They seem not to lead for a long time to distinctly organized worlds of recollection and of phantasy. No one seems to have discovered when "topical" knowledge first emerges under the function of comprehension; though its early beginnings may be looked for when perceptual meanings begin to include a comparative scrutiny of objects, persons or events. Doubtless language greatly encourages the spread of the function of understanding. The adolescent years bring new emotions, especially emotions which suffer elaborate socialization; socialization which pertains as much to the individual himself

as to his personal surroundings. Much that we superficially regard as thinking in the child is only traditional information imbibed without elaboration. Its verbal and logical forms are often deceptive. To command, by a suitable instruction, a problem leading by way of symbols to belief, to conviction, or to the discovery of knowledge is a difficult feat; one which seems not to be accomplished (at least in the average child) until youth is well advanced.

In conclusion it will be well to bring together the facts of development in their relation to the general conditions under which experience proceeds from its most primitive form in the infant toward its maturer stages. The conditions here are the same as those under which the socialization of the individual was found to proceed; namely, stock, growth and exercise of function, physico-chemical exchange with the environment, and association with other organisms. Again we must insist that these "conditions" are really moments, conjointly operative, and not separate factors which independently play upon the organism. Development is, then, a unitary issue of all these factors, a product which is modified from year to year and from stage to stage between birth and adulthood.

1. Stock represents, as we have seen, not a half-dozen or a score of isolated "instincts," each a separate gift of the race, but rather the total body with its functional aptitudes as it is handed over at birth to the fortunes of independent existence.[10] It thus includes the whole morphological plan which stands for phylum, class, genus, species, and racial stock, as well as ancestral peculiarities of the immediate forebears. And it includes, also, the functional aptitudes of the same range of generality and specificity. But we are not to regard the experience of so much as the first day of infancy

[10] Of course, environment and growth have already been affective during the prenatal months; but these facts do not essentially affect our problem.

as *merely* an exhibition of the individual's heritage; for immediately the other factors are added.

2. The organism grows and ripens, and as it grows it exercises itself. More and more are the newer and "higher" parts of the brain thrown into function to inhibit and to initiate. Growth adds strength and exercise brings control. Exercise also brings those modifications of function which we have regarded under habituation and learning.

3. But wanting an outside give-and-take development would be impossible. For us "outside" may conveniently be regarded as "without the nervous system." It thus includes the chemical changes wrought through stimulus and blood supply; it includes the immediate and remote effects of muscular contraction; and, finally, it includes the neural incitement to glandular secretion as well as the returning effects upon the nervous system and upon experience of the glandular products. It now appears that the psychological development of the normal individual is dependent upon the functions of the pituitary, thyroid, suprarenal, sex, and other glands, which make their balanced contributions from stage to stage of mental development.

4. Finally, human association plays its large part. Not only does it contribute to the socializing of the individual. At every stage, from the very earliest, parents, attendants, teachers, play-fellows, acquaintances, historical personages, and the great public make their separate and united impress upon the individual's own career.

Only out of the multiplicity of agencies, therefore, does the individual make his way from the dawn of experience to the mature state of the man.

CHAPTER XX

RACIAL DEVELOPMENT OF THE PSYCHOSOMATIC ORGANISM

Guiding Principles

Our title suggests the discovery of the earliest hint of mind. But a "beginning" which obliges us to trace a continuous process to its inception is not easy to discover. This fact we realize when we attempt to deal sensibly with the beginning of life, or of the earth, of matter or of morality. It may be that there is no such thing as a real "beginning" in these matters; and, if there is, the sciences would seem to have no responsibility beyond the facts which they can command. Our inquiry, then, resolves itself into some such form as this: "Where do we first find substantial evidences of mind or of experience?" or "How far backward into the history of life can the psychologist profitably go in tracing mental development?" Here the student of life stands at an advantage over the psychologist. So great is the difference between the living and the inanimate that the biologist can generally decide—although he has no single criterion of life—whether he is dealing with an organism or with non-living matter. But if he had to declare just when and where animals and plants took separate ways or just when and how reptiles became birds, he would meet the kind of difficulty which confronts the genetic psychologist.

Let us be more specific. We cannot simply carry a lantern into the great dark past and begin to look for mind-in-general or for experience-in-general. We must first gather together certain facts which we have already obtained. Of these, four are of especial pertinence: (1) experience has

yielded us a large number of fundamental qualities; (2) experience has also presented other aspects when regarded integratively and by way of structure and organization; (3) mental and bodily processes have been found to enter into functional combination when the total organism perceives, remembers, understands, and thinks; and to these psychosomatic functions (4) the body contributes certain factors ("energy" and "vehicle") and mind certain other factors ("reference" and "vital indication"). All these are fundamental distinctions which must serve us again in this part of our genetic inquiry.

But these distinctions are not enough. They tell us neither how we are to appraise the mental level of a given animal nor how we are to discern typical differences among the minds of—say—the ape, the domestic dog, the earthworm, the raccoon, the ant, and the protozoan. Here we need the same kind of guidance that the zoölogist and the botanist seek in similar quests. We need, that is to say, guiding or heuristic principles to direct us in our genetic inquiry. Two such principles are at hand. They have been derived inductively from factual observation. The first we may call the *principle of genetic continuity.* It runs as follows: there exists a genetic continuity among the various forms of life and of mind. This principle is borrowed from the student of organic evolution, who finds no factual evidence for gaps or discontinuities which would disrupt what we may call the "blood relationships" which sustain the continuous sequences of life. The second guiding principle may be named the *principle of psychophysiological conjunction.* It observes that the mental and bodily factors are regularly and uniformly conjoined; and it rests upon thousands of such empirical facts as the conjunction of color qualities and visual receptors, the sensimage and processes in the cortex, the associative train and the temporal integration of neuronal tracts.

The Comparative Equation

The first use of our guiding principles appears in the *comparative equation,* an expression derived from the observed fact that mental differences and mental changes stand in a fixed relation to bodily differences and bodily changes. We may express this fixed relation for the human being alone by the expression

$$\frac{M_h}{B_h}$$

where M stands for mind or simple experience, B for body, and the subscript for the human species. For any other animal the expression is written, in its generalized form,

$$\frac{M_a}{B_a}$$

Then, since the relation is, according to the second heuristic principle, invariant, we may write

$$\frac{M_a}{B_a}=\frac{M_h}{B_h}$$

Multiplying both members of the equation by B_a, we have

$$M_a=B_a\left\{\frac{M_h}{B_h}\right\}$$

Now when we compare a given animal form with the human form we take a fixed variety of the latter for our standard of reference. This fixed variety represents all the characteristics common to normal, adult human beings. We may, therefore, regard the human mind M_h and the human

body B_h as known constants, C and K, for the sake of the comparison. and so write the expression

$$M_a = B_a \left\{ \frac{C}{K} \right\}$$

This means that, so far as our use of the comparative equation is concerned, the given animal mind is a function of the same animal's body,

$$M_a = \int B_a,$$

and that the value of M_a is always to be determined by reference to the fixed relation of the human mind and the human body, $\left\{ \frac{C}{K} \right\}$

But to give a concrete meaning to this functional relation the bodily side must be factored. We cannot simply inspect or photograph the white rat, the raccoon, the starfish, or the earthworm. Instead we must ask what are the significant aspects of the creature. For our purposes these significant aspects will include (1) receptor and effector organs (RE), (2) central nervous system (CN), and (3) modes of bodily activity or behavior (BA). Substituting these factors, our functional expression will then read

$$M_a = \int (RE \times CN \times BA).$$

Since we already know by observation our human factors $\frac{C}{K}$, we have then to go to the animal selected for comparison and determine the appropriate psychological factors which hold the same invariant relation to bodily structure, neural function, and behavior.[1] This is equivalent to saying that

[1] It is obvious that the procedure here is a combination of inspection, physical and psychological, and inference. Although no apology has to be offered for the appeal to inference, since all of the sciences depend upon it in a fundamental way, it must be especially safeguarded in its use.

whenever we institute our comparison, we are bound to make *due and just allowance* for differences of all these three bodily kinds.

Concerning these factors, our main lines of inquiry laid down in this volume will lead us to ask three direct questions; namely, (1) What mental qualities are included in the total animal? (2) What is the range of its mental organization? and (3) What psychosomatic functions does it exercise? We take these questions in order, attempting no more than a sketchy outline of the genetical problem.

Qualitative Variety in Racial Experience

Our human researches have made it appear that there is a strict functional dependence of sensational quality upon the receptor organ and the integrity of the central nervous system. So, on the one hand, light and color qualities are functionally related to the eye, tones and noises to the ear, pressure to the skin; and, on the other hand, to specific and interrelated central organs. But we do not find that every new receptor organ or every new receptor region is correlated with a new quality, *e.g.*, pressure and pain are initiated by stimulation of skin, muscle, œsophagus, stomach, and intestine; cold and warmth derive from skin, mucous membrane, and alimentary tract. In general, those receptors which are excited by quite specific forms of energy (as light, sound-waves, chemical composition, and heat) give rise—no matter how the receiving organs are disposed—to specific and unlike qualities of experience.

So long as we remain among the higher vertebrates, we find that the *due and just allowance* to be made for the bodily correlates of the sensational qualities are few and unimportant. All these forms have the same types of central nervous system and about the same equipment of receptors. To be sure, we have to allow for a pachydermatous skin and areally limited pressure-qualities in the elephant and the

rhinoceros, for an apparent absence of the color-eye in some forms, and for a reduction or elimination of the tonal receptors in the cochlea of the simpler vertebrate forms; but, on the whole, these variations give us no reason to believe that there is any wide difference in these qualities among the higher vertebrates. Among the higher invertebrates, the insects and the crustacea are specifically affected by photic, chemical, and thermal stimuli, and probably by sound; and the highly differentiated receptor organs corresponding to these forms of stimulus leave no reasonable doubt with respect to the sensational qualities invoked. In spite of a vast amount of experimentation, some doubt still exists regarding the color qualities among the ants and bees; although it is highly probable that in some of these creatures, at least, certain colors are to be added to light or gray qualities. The structure and integrity of the central nervous system, no less than the receptors, speak for a wide range of these experiential items.

Among the segmented worms we find, on the bodily side, a striking modification. In the earthworm, for example, appears a double neural ganglion for each segment (except the extremes), the segments being joined by strands of neurones. In the head region, the strands pass around the œsophagus and unite above to form a swollen neural mass, the "brain." Scattered throughout the dorsal and lateral parts of the worm are thousands of receptors (Hess's "light cells")[2] which are affected by light; other organs for olfaction (Langdon's "sensory buds")[3] and still others which are responsive to mechanical impact. There is no evidence of tone, noise, or color and only doubtful evidence for pain, warmth, and cold. When we pass to the echinoderms, the starfish, *e.g.*, shows receptors for pressure and for light;

[2] R. Hesse, *Zeitschrift für wissenschaftliche Zoologie* (1895-96), Vol. LXI, p. 393.

[3] F. E. Langdon, *Journal of Morphology* (1895), Vol. XI, p. 193.

but the incomplete integration of the nervous system (in a central ring) leaves us in doubt about the presence of sensational qualities.

The loss in coördination and in central control as we pass toward the lower phyla of invertebrates suggests that we proceed cautiously among these simpler forms for evidence of qualities. First, the close structural and functional relation, in the higher organisms, between nervous and muscular elements, leads us to ask whether muscle and nerve had a common origin in a primitive cell or tissue, possessed at once of receptive and motor characteristics, or had, instead, independent origins and came only subsequently into functional union. It appears now that the contractile muscle-like structure is the older. Its independent existence has been observed in certain of the sponges (Stylotella) in which the intake and outlet pores for water (at the inward and outward pointing arrows in Fig. 36) are opened and closed by surrounding effector tissue which is *directly* acted upon by water currents, injury, and certain drugs. That is to say, no receptor or special transmitting structures are here to be found. Similar independent effectors are known also in higher forms, as in the iris of the vertebrate eye (which may contract under light after the optic nerve has been severed) and in the vertebrate heart muscle, which has been shown in the embryo chick

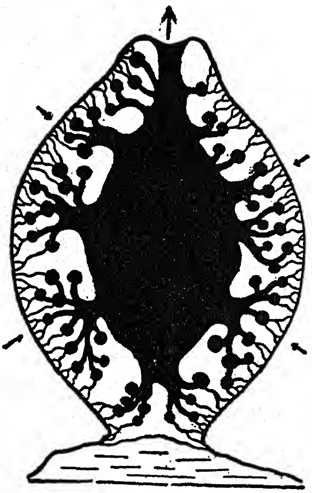


FIG. 36. THE CANAL SYSTEM OF A SPONGE

The superficial pores receive water as shown by the arrows on the sides; the osculum at the apex discharges water. From G. H. Parker, *The Elementary Nervous System* (J. B. Lippincott Co., 1919).

and elsewhere to pulsate before neural structures are at hand. It is only among the cœlenterates (the phylum containing hydra, jellyfish, and sea anemones) that we first find the early appearance of real neuromuscular mechanisms, *i.e.*, of functional units embracing a neural (receiving and transmitting) member and a contracting (muscular) member. The form most studied under experimental control is the sea anemone, a flower-like stalk with a collar of tentacles, sometimes seen attached to rocks and shells in marine aquaria. Upon the deposition of a bit of crab meat or other food at the crown of the animal, the tentacles turn upward and inward over the particle, which approaches the mouth, *o*, and is ingested through the œsophagus, *e*, into the digestive cavity, *d*. No less than thirteen sets of muscles (Parker), most of them lodged in the body wall, are at hand to maintain the position of the animal, to carry food to the interior, to protect it against non-edible substances, to subserve locomotion, etc.

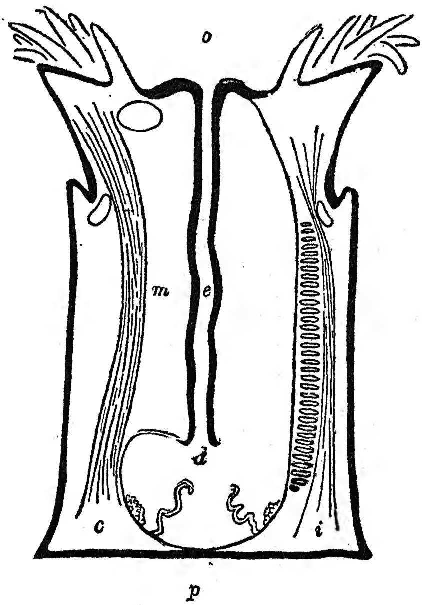


FIG. 37. LONGITUDINAL SECTION OF A SEA ANEMONE

This shows the body wall which extends from the pedal disk, *p*, by which it attaches itself to a support, up to the mouth, *o*, thence down the œsophagus, *e*. There it opens on the digestive cavity, *d*. The œsophagus is held in place by completed mesenteries (*m*) as at *c*. The incomplete mesenteries at *i* do not reach the tube. From G. H. Parker, *The Elementary Nervous System* (J. B. Lippincott Co., 1919).

Standing in close structural relations with these muscles are nerve cells (*g* in Fig. 38) which intercommunicate by means of a system of interlacing strands called a *nerve net*. This conducting net probably lies in the supporting lamella midway between the inner (endodermal) and the outer (ectodermal) layers of the body wall. It leads to no "central" or "adjustor" system and it appears not to be made up of separate neurones connected by synaptic spaces. This nerve net is taken to represent a nervous "system" more primitive than that of the earthworm, of the higher invertebrate phyla, and of the vertebrates. It reappears, however, as subserving purely local functions, alongside the higher forms of nervous structure, in several of the invertebrate phyla (*e.g.*, the arthropods) ; and it has also been discovered in the digestive and circulatory systems of vertebrates. Its function within the organism appears to be the wide general dissemination of the immediate effects of stimulus. Where it exists by itself, *i.e.*, without the more advanced synaptic system, it

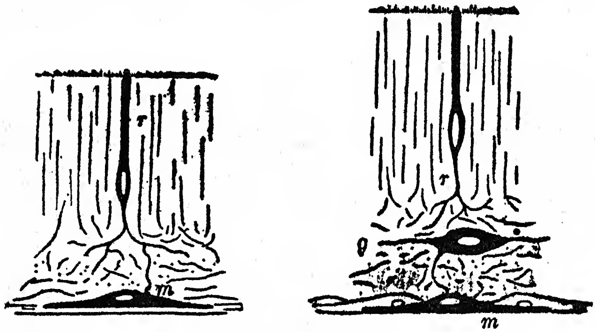


FIG. 38. TWO TYPES OF THE RECEPTOR-EFFECTOR SYSTEM OF THE SEA ANEMONE

The system consists of receptors, *r*, whose nerve net connects them with muscle cells, *m*. The type at the right is complicated by an extra member, *g*, the "protoneurone," whose processes largely make up the nerve net. From G. H. Parker, *The Elementary Nervous System* (J. B. Lippincott Co., 1919).

serves to conduct excitation from any sensitive region throughout the entire organism.[4]

Whether we regard the vertebrate vestiges of the nerve-

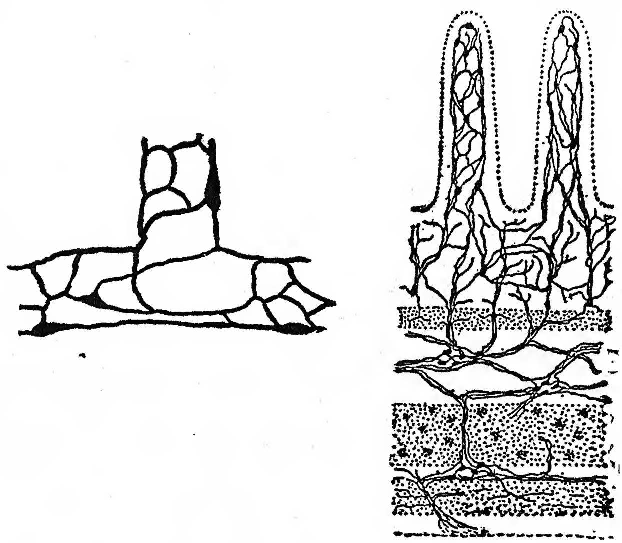


FIG. 39. NERVE-NETS SERVING LOCAL FUNCTIONS IN VERTEBRATES

The figure on the left is the nerve-net from a small blood vessel in the palate of a frog. That on the right shows the intestinal wall of a vertebrate. From G. H. Parker, *The Elementary Nervous Systm* (J. B. Lippincott Co., 1919).

net or the simpler cœlenterates, where *only* the nerve-net exists, we find no evidence that this form of "system" is corre-

[4] Parker found that a mere ribbon cut from the pedal disc and connected to the body by only a slight bridge was excitable by a mechanical stimulus and, moreover, that the excitation was conveyed (at a rate of 121-146 millimeters a second) throughout the entire musculature. Consonant with this diffuse spread of function is the fact that a bit of the nerve-net (*e.g.*, that contained in a single tentacle cut from the sea anemone) displays the same type of response as is found in the entire, unmutilated organism. Even the basal stump perambulated in a "normal" way after the entire top of the stalk had been cut away.

lated with those sensational qualities which lie at the basis of experience. It would seem that specificity in the organic effects of stimulation, as well as specificity in the stimulus itself, had to be worked out in the course of evolution before the qualitative differentiation basal to experience appeared. The first step in this direction was taken when the motor effect of a particular stimulus lay at some distance from the receptor and was reached by a single path, instead of by an indifferent routing through a diffuse and neutral nerve-net. A hint of particular conduction-paths is observed in certain reflex-like movements of the sea anemone itself, notably in the opening of the œsophagus when meat is placed on the tentacles; but it obviously went much further when separate neuronal tracts, isolated nerves, and one-way conduction appeared in the closer synaptic systems.

The higher type of neuro-muscular organization which we begin to observe in such organisms as the earthworm and the leech involves the unitary functioning of the organism-as-a-whole. The balance of evidence from the cœlenterates, on the other hand, stands against organic unity so far as the neuromuscular functions go and in favor of local autonomy with diffusive spread. Such a creature reflects more or less exactly, in a relatively passive physiological state, the momentary condition of stimulation. It has no delicate equilibrium to be upset; and, moreover, changes imposed upon it at large by stimulus do not long remain and do not greatly influence its subsequent career. Here again it stands in sharp contrast to "higher," less stable, and more easily disturbed creatures which are unified by a central nervous system of the synaptic type.[5]

The *sensimages* are more readily disposed of than the primary qualities due immediately to stimulus. Because the

---

[5] J. v. Uexkühl expresses the difference by remarking that the sea anemone's nerve-net partakes more of the nature of a sum of parts than of a unity. *Umwelt und Innenwelt der Tiere* (1909).

former depend upon central functions, of which the evidence from neurology is uncertain, our chief resource is to certain complex forms of behavior which offer fairly good evidence of sensimaginal qualities of very limited range. Here we appeal to certain of the primates below man and to a few other mammals. We have no reason to assume *sensimages* in the lower vertebrates and little reason in the ants and bees. Among the latter, as we well know, specific experiences modify the creature for some time. They "remember," as we loosely say; but that is not to attest memorial imagery.

As for the affective processes, we have not sufficient materials for the certain application of our comparative equation. As we saw long ago, affection appears as the simplest mental exponent of the *general state and temper* of the organism. Pleasantness and unpleasantness stand as *indicators* of the general trend of neural metabolism. They are not sense qualities, and they occupy no local "place." They would seem to be primitive and ancient moments in experience. Of course, we must not confuse them with our gross bodily feelings or with the attitudes of like and dislike, agreeableness or offensiveness, with which we constantly face the world of external and of organic values. The independence of the affections from special receptors or other bodily organs and the reference of them, as indicators, to the general way in which life is moving on, without respect to purely local events within the organism, would seem to give them a very long and ancient lineage. But here again the biologist helps us but little toward the establishment of a one-to-one correlation. We await further evidence.

Integration and Psychosomatic Function

The bodily correlates of mental organization are to be found in all three of the factors in the second term of our equation. Stated in other words, the organization of experience rests upon (1) end-organs of reception and move-

ment, (2) the nervous system, and (3) the bodily activities. This dependence, so far as it relates to human experience, we have surveyed in Chapters iv to vii, where we found a first-hand dependence upon stimulus and receptor, central functions and their residues, and upon kinæsthesis and movement. Now we have to study, in a comparative way, these same factors among other animals and then deduce by inference the relevant facts about integration and function.

In us the simplest groupings are to be found in the primary incorporations of the visual, auditory, and other qualities. These groupings take the three forms, qualitative, extensive, and temporal (pp. 116-20). With these in hand let us examine some moderately simple creature for evidence of their presence. The earthworm is a convenient form.[6] It has been thoroughly studied on the sides of bodily structure and of behavior, and we have, moreover, discovered in it the essential bodily correlates of experience.

We find in the earthworm nothing to suggest such clear-cut incorporations as those of rhythm, melody, and visual figure. The conditions are wanting for the sharp differentiation of quality such as these mental configurations imply. Audition is eliminated, vision is poor in quality (possibly only a gray at variable intensities), no retinal image reflects the parts of objects, since light falls diffusively over large light-receptor fields. When thrown upon small areas (the rest of the body surface being kept in the dark) light does lead, to be sure, to some variety in the promptness and in the character of movement. Thus a recoiling movement follows the selective stimulation of the head-end; a lifting and

[6] The writer has for several years studied the earthworm and related forms under the experimental conditions of the psychological laboratory. The precise comparative study of a few representative forms obviously offers our most promising introduction to the genetical problems of psychological development.

lateral throw of the anterior segments is induced by light on other areas, and a forward movement by the stimulation of the posterior segments. There is nothing here to suggest the visual patterns which give us the perception of objects; though a fixed temporal conjunction of a specific movement with the light excitation should provide three or four visual-somæsthetic patterns of a low order of integration. We get the same result when we substitute for light a chemical stimulus (*e.g.*, oil of cloves) or a tactile stimulus (a smooth glass rod). The same differences of movement here follow upon the stimulation of the different areas. The general spread of receptor and movement organs over the surface of the animal stands against precise integration in any single sense; although the shading of the visual-, chemical-, or tactual-kinæsthetic complex would suggest something like a primitive perception of place. Since, however, the earthworm lacks our means for a general apprehension of the body (tactual and visual surveys), we must not identify this rudimental reference of sensory groups with our own highly elaborated perceptions of space. The waving movements of the head-end and the characteristic right-throw or left-throw of these segments [7] under stimulation would seem to involve slightly different patterns of the same kind. Whether this right-leftness has any hint of spatiality in it is doubtful. If it has, it is probably a simple "hereness" and "thereness" without even a primitive perception of movement through a closed and continuous space. As every one knows, the chief form of bodily movement of the worm is due to a progressive contraction of muscles beginning near one end and running with a kind of ripple along the segments. This movement is immediately controlled by the local ganglia; but it is also influenced by pulls from anterior or posterior segments. It

[7] Some individuals exaggerate the right-throw; others the left. This functional asymmetry is carried further in our prevailing right-handedness.

may continue when the worm is severed and sewn loosely together by thread, as it may also pass over a limited area where the neural cord has been destroyed or excised. These facts show the weak central (brain) control over bodily movements; but they do not speak against a general flowing pattern of somæsthetic qualities, reversible in order during regressive movement.

Important in this connection is the fact that the earthworm is covered with mucous and that it commonly moves within a cylindrical tube of its own construction. Taking this fact together with the preceding facts of bodily structure and activity, we shall discover that the behavior of the creature is more like the peristaltic and secretory operations of our visceral organs than it is like our free movement among objects; and also that its mental integrations more closely resemble our "organic" experiences from the abdominal viscera than the visual, auditory, and tactual patterns locally determined by sharply defined types of stimulus. We must omit, however, the cognitive survey and the emotional valuations which we impose upon the immediate report of our own visceral functions.

Those integrating occasions—common with us—which enable the organism to grasp, destroy, or manipulate its surroundings are rare in the earthworm. This creature has little commerce with *objects*. The exceptions appear under such circumstances as the following. Burrowing or tunneling. This operation would not seem to have great significance for experience. Although we have no accurate description of the activity, it appears to consist in a wearing down and ingestion of the earth at the end of the tubular opening, a process which is well designed to furnish tactual and kinæsthetic qualities, but not to integrate these into characteristic patterns. Copulation. This hermaphroditic worm offers no evidence of a perception of the mate; though the tumescence of glands would seem to contribute to experience a factor not

unlike that of sudden glandular changes in higher forms. Feeding. Darwin[8] thought that the discrimination of foods and the introduction of small leaves into the nest called for a nice perception of objects. Although the writer has repeatedly encouraged the earthworm to "search out" food, he has not discovered, in his own or in other experiments, conclusive evidence of this type of performance. The creature often moves away (by the simple device of throwing its head-segments between crawling movements); but never, so far as we know, does it take an aggressive attitude toward objects of food. A repetition[9] of Darwin's observations upon the "selection" of suitably shaped leaves for the burrow leads us to doubt a direct apprehension of the properties of moved objects.[10]

When we pass from the worms to the insects, and especially to the higher insects, we come upon bodily modifications which have the greatest significance for the integration and the uses of experience. Let us see what they are.

In the ant and the bee, to take only two instances, we find creatures possessed of well-formed mandibles, three pairs of legs, two kinds of highly developed eyes, a modification of

---

[8] C. Darwin, *The Formation of Vegetable Mold through the Action of Worms, with Observations on Their Habits* (1882).

[9] E. Hanel, "Ein Beitrag zur 'Psychologie' der Regenwürmer," *Zeitschrift für allgemeine Physiologie* (1904), Vol. IV, p. 244. *Cf.* G. Kafka, *Einführung in die Tierpsychologie,* etc. (1914), pp. 494-495. In commenting upon Darwin's "scientific record" of this "staggering" performance of the earthworm, W. McDougall generously attributes to the creature "appreciation," "comparison," "choice," "judgment," and "purpose" (*Outline of Psychology* (1923), pp. 68-69). A more careful reading and interpretation of Hanel and Kafka might have tempered McDougall's high opinion of the intellectual excellences of the earthworm.

[10] The beginnings of this perception of objects may be present in certain flatworms (a simpler, unsegmented form) which halt upon passing over a particle of food, "hug" it by bending the anterior end about it, and so hold it while the everted pharynx pours out digestive juices.

segments into well-marked regions (abdominal, thoracic, and cephalic), centralization of the body ganglia, and a fairly complex brain. There appear, besides, strongly marked differences of sex as well as polymorphic variations which are reflected in colonial function. Many other details of structure we need not describe. The advance in form from the worm brings modification of behavior which is even more striking. Here we have a creature which seeks, transports and stores its food, carries its young, "tends" eggs and larvae, prepares a nest, and lives, at times, in colonial association with others. We may, therefore, well expect to reach a solution for our comparative equation quite different from that derived for the earthworm.

First, advancement in the receptors themselves gives us a clew to the new integrations; definite visual patterns of wide qualitative range from the compound eyes, and tastes and smells from the localized chemical receptors lodged in the mouth-parts and in the joints of the moveable antennæ. But still more important for the development of experience and of the psychosomatic functions are the bodily movements which make possible the varied activities just recited. Rapid locomotion, when combined with the grasping movements of the mandibles and the exploratory movements of the antennæ, integrates a large number of sensory qualities, which (together with the bodily resources) give rise to the perception of food, of young, of nest-fellows and strangers, and of the region within which the insect lives. The fact that the insect is, when mature, almost immediately able to use its actional means for carrying on the essential functions of life has led many to the belief that the ant and the bee are creatures of "instinct," incapable of experience in our sense and incapable, therefore, of modifying experience and its own performances in the light of accomplishment. But no one who has observed these insects for months together under controlled conditions is able to accept such a

belief. For he constantly acquires first-hand evidence of perceptive and executive functions and of the rapid modification of these functions from day to day and from hour to hour. As in our own human exercise of these operations, kinæsthesis, touch, vision, taste, and smell play their respec-

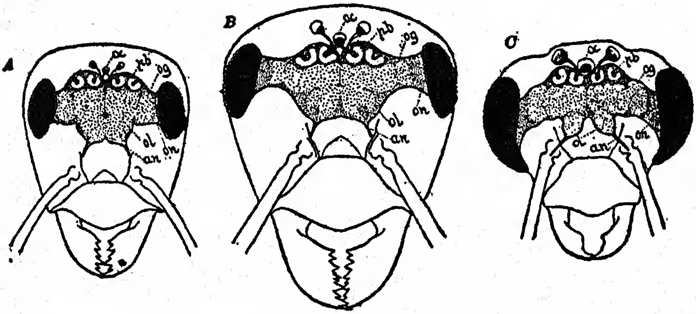


FIG 41. BRAIN, EYES, AND OCELLI OF THE ANT, *Formica fusca.* THE HEAD *A* IS FROM THE WORKER, *B* FROM THE FEMALE, AND *C* FROM THE MALE.
From W. M. Wheeler, *Ants, Their Structure, Development and Behavior* (Columbia University Press, N. Y., 1910).

tive parts; though in different measure and unlike combinations because of bodily disparity and of unlike modes of living. In particular, olfactory structures play a more important rôle in the ant and bee. It appears from the experiments of the comparative laboratory that in the apprehension and the discrimination of the young, in "finding the way," in the recognition of nest-fellows, and in the apprehension of food smell-complexes play a major part. As for memory, in our strict sense of the apprehension of objects and events as past, there is no convincing evidence; though the modification of performance by way of past events is constantly to be noted. This modification depends, in part, upon the simplification of repeated bodily functions and, in part, upon the increase of meaning in cumulative experience.

Thus the worker ant who wanders at random over a new experimental field, a larva fixed in her mandibles, may within an hour be passing directly to and fro without hesitation or variation and depositing the young within the nest. At times, she uses visual landmarks, at times the source of light, again

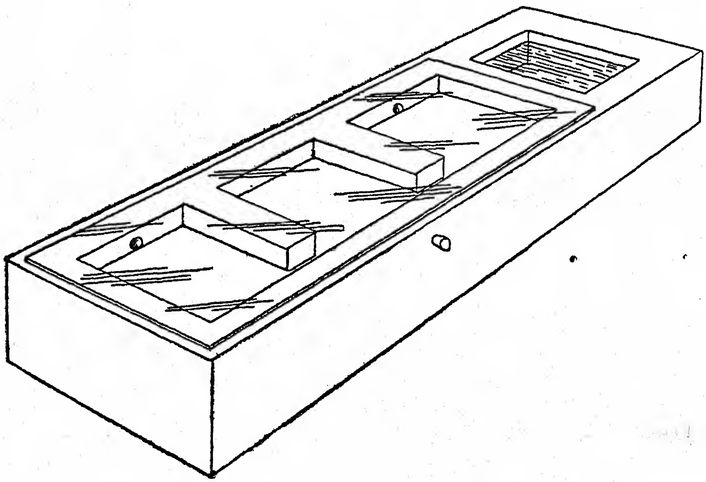


FIG. 42. ANT NEST WITH THREE CONNECTING CHAMBERS; THE RESERVOIR AT RIGHT MOISTENS THE NEST

the contours of the path, and yet again the olfactory marks upon her way. Although abstractive perception (p. 245) appears to be present, we have no evidence of imagination, none of comprehension, and none of thinking or "reflection." A review of the forms of action (Chapter xii) brings us to recognize the simpler forms here, including the hesitant variety; but not any "willed" action, which demands a reference to the "self" as an agent. Perceptive and actional situations appear to bring a few simple predicaments, as in the difficult rescue of young in the presence of an "outsider." But we must make due allowance for morphological dis-

similarity and for wide difference in experience (to say nothing of language) before we seek to identify the insect's emotions with our own. As for the "socialization," of which we hear so much among the "social" ants, bees, and wasps, it is chiefly of the perceptive and actional kind. Our first-hand observations—when they are made without foregone convictions—lend little support to the popular belief in pre-arrangements and working plans, hearty good will and kindly toleration, submission to rulers and coöperative endeavor, which have been imaginatively read into the operations of the ant hill and of the bee hive. For the greater part, the individual performs entirely upon his own, ignoring the like performance of other individuals. Without imagination there would be no "shared" goal, and, wanting the resources for understanding, common topics would not appear.

With the early chordate and vertebrate animals we obviously recede to much simpler forms of experience and of psychosomatic function. It is, we may say, only when we advance to certain orders among the birds that we come again upon anything like the variety and the richness which we have found in the higher insects. Only one or two points of difference can be noted. Vision usually plays a larger rôle here, both on account of the ocular structures and of the avian habits of living. In many forms, visual perception is wide and rich with a corresponding decline (save in some raptorial birds) in olfaction. In the second place, the young bird lives through a period of immaturity under the care of one or of both parents. And, in the third place, the experience of the bird is profoundly affected by a long and complicated reproductive cycle which undoubtedly serves to develop the emotive and actional resources, to extend and vary its perceptual experience, and to give a deeper coloring to the socialization of its basal functions. Here we find the indicatory aspect of mind coming into prominence as

the turns and tides of life succeed in diverting and directing the course of experience.

With the development of mammalian forms, we find life taking many courses; each course laying its own emphasis upon some particular function or group of functions. But these emphases pertain more to the extension of a given function toward its limit than to the evolution of any new basal function. Thus, the hunted animal might excel in quickness or promptness of action, the remote and lofty eagle in keenness of vision, and the carnivore in delicacy of olfactive perception. Again, monogamous mating, family life with a local habitation, and life in the pack or herd may differently tune the organism toward function, setting the individual toward the emotions of aggressive possession or of protection or toward an imitative following of others. Of late, evidence has been accumulating of a topical extension of perceptive meanings which has given to some of the higher vertebrates the beginnings of comprehension or of insight into significant situations. It appears likely that this first "understanding" has been devised without the intervention of "ideas." We must observe also that special bodily devices, such as the trunk of the elephant or the manipulative hand of the squirrel and raccoon, naturally lead to a functional extension and differentiation. But until the advent of sensimaginal processes set in suitable patterns for memory and imagination, no great advance has appeared in the experience of the higher vertebrate forms. Not even the advent of the cochlear labyrinth (the last great sensory organ), which has extended auditory perception by a vast array of tonal qualities, appears to have led on to a functional development of any great magnitude. The integrations not immediately representative of "present" objects and conditions, however, have changed the face of experience. They have brought memorial and imaginative apprehensions, a broadening of perceptive meanings, new far-reaching forms

of action and emotion, and they have led the way toward understanding and thinking. By-products of this evolution were language, the continuity of times past, present, and future, and the accumulation of tradition and knowledge.

Only the beginnings of this great change appear in the primates below man and in a few of the other mammals. Our experimental evidence is very meager. Recent work with the monkeys suggests that when we know the higher mammals better we shall better understand the precise changes in our three somatic factors which introduced this very great advance in the psychosomatic functions. It may be, of course, that the gradual enrichment of the cerebral cortex, of neuronal systems, and of the agencies of inhibition and control was, for a long time, preparing the organism for these new functions which did not, however, come to flower until some great need appeared, a need (possibly life in the treeless plain) which may have been coincident with a great bifurcation in the primate line of descent. These matters are all speculative.

The reader will note the absence of that factor in our genetic description which is commonly called "brightness" or "intelligence." He may even protest that the most highly developed mind is just the brightest or the "brainiest" mind, and that we have missed the whole point of mental development. A moment's reference to our sections upon the limits of psychosomatic function, however, should set us straight. When we say that an animal is "bright" or "clever" we speak of what he *accomplishes*. Thus we regard the fox as exceedingly "clever" and "intelligent" when he outwits his pursuers and comes safely to cover. It is the *product* that we consider and not the particular process or operation that has been used to attain it. The ease with which we are taken in by this substitution of outcome for function appears when we extol the stupid but highly trained horse or dog in the circus as having "almost human intelligence." As we

have contended in another connection (p. 200) our measurement of product is a poor indication of what the psychosomatic organism is actually doing. If the organism were like an engine doing only one thing and built to serve only one end, then we might equate its extreme performance with its stage of development. As we place the fastest motor car and the highest flying airplane at the top of our series, so we should, then, take the brightest score in a given test to represent the most highly developed mind. Such a quantitative or "valuational" notion would be useful in grading school children or possibly in selecting clerks for a vacancy; but it is no better designed for defining mental development than a rating for growth, size, food consumption, or the manufacture of starch would serve the botanist and the zoölogist as a quantitative measure of the developmental position of plants and animals.

APPENDIX

NOTE ON CHAPTER XV (*see* p. 360)

This determination in thinking, which is alleged to stand outside the actual elaboration and yet to provide for it, has been variously conceived by psychologists. Ach made an intensive study of it by the examination of the preparatory period of the reaction experiment. Although his study bore directly upon action, Ach's view of determination led him and also others to apply it to the problem of thinking. The observer was instructed to move his hand in such-and-such a way when such-and-such an object was visually presented. Here even more clearly and definitely than in the task of thinking (as in Watt's experiments) the preparatory period is signalized by a fixed anticipation. Ach found, upon the side of meaning, a prophetic idea of the movement or performance which was related to the coming stimulus-object, and, on the side of the nervous system, the initiation of a determining tendency. G. E. Müller rejects the determining tendency, which he regards as a voluntaristic concept of a "mysterious sort"; but he substitutes something very much like it in his "idea of goal" (*Zielvorstellung*) or "directive idea" (*Richtungsvorstellung*) plus a mental "disposition" (*Zur Analyse,* iii, 540). On Müller's admission, the goal-idea (virtually Watt's "task," with a wider connotation to include self-instruction) has a peculiar and impressive efficacy. It commands attention, it possesses "interest," and interest serves to lend it a stronger perseveration and a greater associative effectiveness (429). Since both parties to the controversy have in mind the same functional fact, variously called the "task," the "awareness," the "determining tendency," and the "goal-idea"—a fact of the first importance to the psychology of thinking and action—we may retain the names to express, as occasion demands, its various aspects. We shall not assume with Ach that the determining tendency connotes an unique factor of "will" ultimately different in kind from the reproductive tendencies of Müller. At the same time, all the factual descriptions imply that the task (whether carried psychosomati-

cally or in purely neural terms) has a distinctive issue in the thought and action solutions, not common to other associative formations. At present we may only say that the thought task represents a total psychosomatic posture, or functional state, which releases or commands a group or constellation of neural processes relevant to the proposed problem. It may be only a peculiar grouping of reproductive tendencies (whatever in the nervous system these precisely are—possibly a disposition of energy) which are capable of furnishing the materials necessary to a novel solution. As in the case of perception, the connection is a meaning-connection, *i. e.*, matters relevant to a solution are assembled. But in thought the assembling derives, not from an arrangement of stimulus, not wholly from any previous central integration, but from a problem which somehow invites the presence of symbolic tools appropriate to elaboration.

When we put together Watt's thought-task and Ach's determining tendency, we really have characterized from the two sides, mental and bodily, one and the same thing, namely that stage of a unitary psychosomatic function which lays the train for, and develops into, the second, *i. e.*, the elaborating stage in thinking and the performing stage in action.

No more than in the other functions previously treated do we have to seek out an exact parallelism between mental processes and cerebral activity. That would be like assigning certain molecules of an expanding gas to the movement of the cylinders in the gas-engine and others to the propulsion of the car. All that we are bound to do is to search out the resources of both kinds and to note the course and progress of the operation from beginning to end.

The debate upon the "determination" of thought turns as often upon terms and standpoint as upon the actual facts. The Müllerian or Göttingen party denies the existence of the attitude (*Bewusstseinslage*), the awareness (*Bewusstheit*), the "imageless" thought, and the thought elements (*Gedankenelemente*). preferring to write their entire psychology in associational terms. The chief opposing party, which has sprung from the laboratory at Leipzig and the "Würzburg School," is friendly to the voluntaristic psychology of Wundt, making use of apperception and of a multiplicity of feelings and "activities." It has made extensive use of a peculiar method, the method of "question-and-answer" or "examination" (*Ausfragemethode*), which Wundt condemned as unscientific (*Psychologische Studien,* 1907, iii, 334; *Archiv für*

die gesamte Psychologie, 1908, xi, 445). In the hands of Messer and Bühler, the standpoint came to be that of "intellectualism" as set against "sensationalism" and "associationism." The chief exposition and defense of a descriptive account of thought and action in terms of association and reproduction have been made by Müller. His long series of studies culminating in the compendious publication, *Zur Analyse der Gedächtnistätigkeit und des Vorstellungsverlaufes* (3 vols, 1911-17), is among the most notable of all inquiries into the psychosomatic functions. Although Müller is not wholly clear upon the distinction between process and function, his ideas (*Vorstellungen*) are, for the greater part, meanings, sometimes primary and sometimes symbolic; and the flow of these ideas he seeks to bring under the "laws of reproduction" (*Reproduktionsgesetze*). In rejecting "attitude," *Bewusstheiten*, and the rest, Müller does not merely substitute the old formal laws of contiguity and resemblance, but instead uniformities which have been substantiated by experiment; *i. e.*, the laws of substitution, perseveration, inhibition, coöperation and convergence. In addition, he makes use of the laws of "limited range" and of "transitoriness" (*Enge und Unbeständigkeit des Bewusstseins*), of the facts of attention, and of the hypotheses of predisposition (*Einstellung*) and central, non-mental influences (*apsychonome Einflüsse*). "Man verstehe den Ausdruck 'Erklärung durch die Reproduktionsgesetze' stets in dem durch diese Einschränkungen gebotenen relativen Sinne" (iii, 426, footnote). Although this associational psychology makes free use of many conceptual terms, *e. g.*, "active recall," "memorial activity," "directional" and "goal" ideas, "perseveration" and *Bereitschaft*, its methods are more empirical and its factual materials more nearly adequate than are those of the opposing party.

The awareness of Ach is, so Müller contends, either a group of fleeting and obscure ideas, like any other bit of information, or else it is "knowledge" of the same kind as knowledge of one's own name, of one's birthplace, of one's ability to remember the names of the American presidents or the ability to carry through a complicated action or to withstand hardship; *i. e.*, it is *potential* knowledge;—an assurance that one could, upon occasion, name, remember, do, think out, or endure. When one says, "I know my name" or "I know that piece of music," the name or the composition is not actually present. "To know" in these cases then expresses not real knowledge, as of something now experienced

in detail, but a conviction that one has such and such resources at command. Remember that these alleged awarenesses come with repetition and practice; that is to say, after the observer has time after time carried through the task, and may therefore reasonably expect himself to succeed at the next attempt. The point is important. It will not do to import into the plain description of thinking a confusion of knowing-now-in-process and a sheer posture of conviction. This posture represents rather the indicative than the referring and objectifying aspect of experience, and we should not therefore expect to find an elaborate mass of meaning supported by an equally elaborate mass of sensation and sensimage. To speak then of "imageless" thinking in such a case is both misleading and confusing. Again we must—so long as we hold the functional view of the organism—free ourselves from the doctrine of "parallelism" and accept just what we find to be actually present in the operation.

INDEX OF NAMES

INDEX OF SUBJECTS

(1)